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INCANDESCENT LAMPS AS STANDARDS OF LUMINOUS INTENSITY.

At the June meeting of the New York Section of the Illuminating Engineering Society a very interesting paper was presented by Messrs. Sharp and Millar on the subject of incandescent lamps as standards of luminous intensity. As the paper points out, the development and production of standard incandescent lamps has attained considerable importance because they have become the actual preservers of our international values of luminous intensity or candle-power. Several countries keep, in their standard laboratories, certain standard flames to look at, such as the pentane, carcel and hefner flames; but when accurate measurements and careful photometric comparisons are considered these flames are set aside in favor of a set of seasoned and internationally standardized incandescent lamps. An interesting detail in the process of seasoning standard carbon incandescent lamps is their careful measurement, in regard to resistance. As soon as their resistance becomes steady they are accepted as seasoned, and seasonable. The paper contains a very clear historical statement of the origin and development of the new international unit of candle-power. Incidentally, it is pointed out that the wattmeter bears a more direct and intimate relation to the luminous behaviour of an incandescent lamp than the voltmeter; so that precision wattmeters are more important than precision voltmeters in this connection.

THE USE OF THE OSCILLOGRAPH IN FUSE TESTING.

When a mild short-circuit occurs in the wiring of the ordinary office building or dwelling house, there is, in nearly every case, a relatively high resistance between the generator sources and the short-circuit, in the form of relatively long and slender intermediate conductors. Consequently, the ordinary short-circuit causes an enclosed fuse to melt so quietly that a person standing close beside it would seldom have the fact revealed to his senses. But when, on the contrary, a heavy short-circuit occurs close to a central-station switchboard, particularly if a large storage battery is connected directly to the same, the fuse which has to open the circuit has a heavy duty to perform. The current rushes through the fuse at a tremendous rate of increase. An arc forms within the fuse metal after the first one or two milliseconds, and this arc, expanding laterally, injects itself into the interstices of the cartridge filling. The cool filling material now absorbs the heat from the arc-vapor, like a sponge. Two keenly contesting forces are now opposed. On the one hand, the potential difference is rapidly rising across the fuse terminals, throwing rapidly increasing heat and energy into the arc-vapor. On the other hand, the chill of the filling material quenches the heat, and the conductance of the arc. If within the first two hundredths of a second, the cooling effect conquers, the fuse opens the circuit. If it fails within that time, the increase of energy blows the cartridge to pieces explosively. A paper on the subject of oscillographic tests of enclosed fuses was read by Mr. Alexander Maxwell at the recent St. Louis N. E. L. A. convention. It showed that with 100-amp fuses, blown at

230 volts, on fairly heavy short-circuits, the electric input to the cartridges was 3 or 4 pound-Fahrenheit thermal units. When it is remembered that the powder energy in an ordinary rifle cartridge is about 8 thermal units, the significance of this condition becomes appreciated. In a paper read by Mr. L. W. Downes, last year, before the American Institute of Electrical engineers, some still more severe short-circuit oscillographic records of fuse meltings were produced. These showed that when 80-amp fuses were blown directly across the terminals of a large storage battery at 500 or 600 volts potential-difference, the input was about 20 thermal units, if the action was quiet. When the input increased beyond 30 thermal units, the cartridge usually burst explosively.

PHOTOMETRIC UNITS AND NOMENCLATURE.

A paper by Dr. Rosa on the above important question, read at the last meeting of the New York Section of the Illuminating Engineering Society, is particularly useful because it states briefly, with a physicist's precision, the fundamental relations between the various photometric units in use. It goes further than this, because it discusses a number of important geometrical cases of light sources, and gives the formulas pertaining to each. As regards the symbology employed, there will probably be some differences of opinion. The principal symbols used are I, F, E, Q and L, for luminous intensity, flux, illumination, quantity and lighting respectively. On the one hand, these symbols are already in general use for electrical quantities in electrical engineering, except F, which is commonly used for force in mechanical engineering. On the other hand, it may be urged that the fields of illuminating engineering and electrical engineering are sufficiently far apart to permit of using the same set of symbols without serious ambiguity. There is something to be said for the latter argument, but the question is one which should be debated. The great majority of members of the Illuminating Engineering Society are electrical men, who probably would not favor the use of I and E in two acceptances; and the members in general of the society would doubtless appreciate the incongruity of the appearance of neighboring papers in the *Transactions*, one treating of photometry and another of electric lighting, in which the same symbols were employed in entirely different senses.

ELECTRIFICATION OF INSULATING MATERIALS.

An interesting paper on the above topic has recently been read before the Glasgow section of the Institution of Electrical Engineers in Great Britain by Mr. W. Jamieson, as referred to in the Digest. It is well known that when two different substances are rubbed together they become oppositely electrified. This fact was the earliest observed, or at least the earliest recorded, electrical phenomenon, attributed to Thales, of Miletus, in relation to rubbed amber, whence electricity has received its name. We may paraphrase the fact, for theoretical purposes, by saying that when molecules of different kinds are brought into active contact their electrical conditions are mutually disturbed. It has not been generally known, if known at all, that the mere distortion of an insulating material, like celluloid, so as to throw some of its layers into tension and others into compression, brings about electrification in the material. If two strips of sheet celluloid are superposed, and drawn between the finger and thumb, they become oppositely electrified. According to this principle, electrification does not necessarily involve the contact of dissimilar molecules. It may be produced by stress exerted upon a mass of similar molecules.

The phenomenon requires, however, to be carefully investigated to make sure that the presence of no second kind of molecule is really needed in this curious stress electrification. For example, it is quite conceivable that if the stresses of compression and extension were applied in vacuo, no electrification might ensue. In other words, it is conceivable that a thin layer of occluded air might be an essential element in the production of electrification when two strips of burnished celluloid are drawn between the fingers. It was suggested in the discussion on the paper that the well-known electrification of the rapidly moving belts of belt-driven machinery might be due to the extension and compression stresses exerted in the belt. But as was pointed out, there is commonly an appreciable amount of slip in a belt, and this slip is necessarily accompanied by friction, which would account, in itself, for the electrification. In fact, it is almost impossible to run a belt over pulleys so tightly as not to slip slightly during the process. A stroboscopic fork, applied to determine the speed of a belt-driven machine, never gives so sharp a picture of the rotating target as when applied to a direct-connected machine. The blur in the picture of the belt-driven target can always be made worse by slackening the driving belt, and is manifestly due to belt slip; but no reasonable amount of belt tightening will, on the other hand, serve to destroy the blur completely.

SHUNT-CONDUCTANCE AND SYMBOLIC METHODS OF SOLVING ALTERNATING-CURRENT PROBLEMS.

A condition with which electrical engineers are so familiar that they seldom or never give it any consideration is, that with almost no exception an engineering graduate when called upon to determine the unknown components of an impedance of known value, treats the resistance component as being joined in series with the reactance component. That the impedance could equally as well be made up of a certain resistance connected in parallel with a proper reactance is almost never considered. It should be unnecessary to call attention to the fact that in a constant-potential circuit, such as is in common use today, the equivalent impedance is formed of many impedances joined in parallel, and that the conception of universal series relation, which was based on earlier types of circuits now very seldom employed, may lead to erroneous conclusions. In dealing with the older series-connected circuits it was quite appropriate to treat of impedance as a resistance in series with reactance; but in the case of numerous present-day problems relating to shunt-connected circuits, it is far preferable to base the solutions on the admittance which is made up of conductance and susceptance.

It is difficult to understand why the older series-impedance method of solving alternating-current problems has been so long adhered to when almost all teachers at the present time appreciate the greater convenience of the shunt-admittance method when dealing with the practically universal constant-potential circuits, and understand fully the advantages of acquiring facility in handling both methods. It is not improbable that a certain portion of the difficulty encountered in introducing the latter method has been attributable to the assumption, frequently implied, that this method is associated with the

"symbolic" method of representing alternating-current quantities, and cannot be divorced therefrom. The symbolic method possesses features that render it highly desirable for use in numerous cases, quite independent of the shunt-admittance method; and the latter method loses none of its good features when used without any reference whatsoever to the symbolic representation of alternating-current quantities. Evidently better results can be obtained when two excellent non-conflicting methods are used in combination than when one is used alone, but it is unfortunate if the attempts to introduce the two methods simultaneously has retarded the introduction of both.

The chief feature of the "symbolic" method, which is always used simultaneously with both the "shunt-admittance" and "series-impedance" methods, are outlined in numerous textbooks. The method has been employed to some extent for instructional purposes and in engineering calculations, but it deserves to be applied to a much greater extent than at present. In order to avoid unnecessary confusion in the mind of those not accustomed to making use of symbolic equations, it may be stated that for most purposes the method involves merely the substitution of an equivalent expression for the familiar radical sign when denoting the square root of the sum of the squares of quantities placed thereunder. Thus the "complex imaginary" quantity $r \pm jx$, involving the imaginary unit j, is to be treated as merely a convenient expression for $\sqrt{r^2 + x^2}$. In the shunt-admittance method use is made of the reciprocal of the impedance Z, which is known as the admittance and denoted by the letter Y; its power component, g, is called the conductance, and its wattless component, b, is known as the susceptance. It should be noted especially that the conductance is not the reciprocal of the resistance, and the susceptance is not the reciprocal of the reactance. The exact relation between these quantities is shown in an article in this issue by Mr. G. F. Marsh, which contains certain general expressions for the relations in alternating-current circuits based upon the symbolic method of representation. An article giving specific applications of the methods to the solution of problems involving star-connected three-phase circuits by Prof. Harry P. Wood also appears in this issue.

SIMPLE RULES FOR CALCULATING FURNACE ELECTRODES.

The article by Mr. Carl Hering on furnace electrodes, printed elsewhere in this issue, brings to completion a long series of measurements and calculations on the design of furnace electrodes. Being the last in the series it contains the summation of all that have preceded, so that it is the more deserving of examination by electric furnace engineers, especially as it is reduced to the simplest terms of statement, both in the English and in quantitative expression. Algebra is a wonderfully powerful weapon, but its user must sacrifice some advantage for the privilege of its adoption. In simplicity, and in directness, algebra must yield the palm to arithmetic, when dealing with a subject that is thoroughly understood. Arithmetic, indeed, disdains to stay where knowledge has not made sufficient preparations for her sojourn. When a writer, therefore, sets algebra on the shelf, and explains his meaning in arithmetic, confidence is bred in his concrete knowledge of the subject he discusses. More than a year ago Mr. Hering attacked the problem of the proper design of furnace electrodes. The purpose of such electrodes is to carry the working current through the furnace. Incidentally, in addition to the cost of electrodes, both in first purchase and in depreciation, they are subject to two kinds of expenditures or losses, namely, (1) thermal conduction losses, whereby heat is conducted through them from the furnace, like water through drain pipes; and (2) joulean or I^2R losses, whereby power must be expended electrically in heating the electrodes by the passage of the working current.

These phenomena, although associated in the electrodes, are essentially distinct, obeying separate laws, and acting independently of each other. Mr. Hering showed algebraically, among other things, that it so happens the total waste of power, due to heat conduction and I^2R combined, will be a minimum in the electrodes when there ceases to be any resultant escape of heat from the furnace through the electrodes; that is, when the I^2R heat flow into the furnace equals and cancels the thermal conduction flow out of the furnace. The above result was a remarkable one, and apparently had not been previously published. Some persons seemed to think, after reading the paper containing the demonstration, that they had known it all along. The fact is, however, that once a stream has discharged fresh water into the great ocean of recognized truth, it is very hard to maintain the distinction between the old and the new. Once our minds recognize a new truth, such is the nature of our mental processes that we seem to have dwelt forever in its luster. There is no sense of time to the eternally true. Nevertheless, although Mr. Hering's demonstration contained no loophole for doubt, on the basis of constant electric and thermal conductivities throughout the electrode, yet it was pointed out by various critics that with the large difference of temperature which necessarily exists between the inner and outer ends of a working furnace electrode, there might be considerable differences in these conductivities at different points along the electrode, and consequently the conclusions might be entirely upset.

It has since been shown, however, that although, theoretically speaking, large variations in electric and thermal conductivity along the electrodes might give rise to large deviations from Hering's law if the electrode were long enough, and varied sufficiently in conductivities, yet, under practical conditions of length and conductivities, the corrections involved were negligibly small for engineering purposes. Hering's law of minimum power waste and zero heat escape from the furnace is, therefore, practically sound, and is likely to be classical. It is not merely an intellectual truism, it is also a highly practical rule. If the rule is neglected, there will probably be either a chilling of the furnace by thermal cooling near the entrance of the electrodes, or a superheating of the electrodes in the walls, with a tendency to more rapid disintegration; or an unnecessary waste of power. The question is quite important. The criticism which was aroused by Mr. Hering's original paper aroused Mr. Hering in return, and forms an excellent illustration of the psychological value of dissension. A critical environment stimulates the demonstrator. Hardly was the argument cool before Mr. Hering began to heat up an experimental furnace, in which to test the data underlying the new electrode law. The results of that research have not only sustained the original proposition, within the limits of existing engineering needs, but they have also enabled the results to be expressed in the very simple yet comprehensiye table appended to Mr. Hering's article. The data are now so simple in form that no electric furnace designer can have any difficulty in understanding them.

Central-Station Census Statistics.

An announcement was printed last week of the United States census report of central stations, now on the press, and below is given further information summarized from the report.

The report classifies central stations as "commercial" and "municipal"; the former being those operated under private ownership, whether by individuals, companies or corporations, and the latter being those operated by state, city or other local governments, except those operated especially for institutions.

The central stations are further classed as "purely electric" central stations, or those that do a strictly electrical business, and "composite" central stations, or those operated in connection with some other industry. It is stated that the majority of the central stations are of the "purely electric" class.

With reference to the municipal stations, the report states that these plants are generally established primarily to furnish current for lighting public buildings, streets and parks. Their field of operation is, however, much like that of the commercial stations.

It is noted in the report that the figures given for the central stations do not represent the entire production of electrical energy. To arrive at the aggregate it would be necessary, it is stated, to consider also the electric railways, telephone and telegraph lines, electric police-patrol and fire-alarm systems, and the isolated electric plants.

In the first chapter of the report, which is a general discussion of the subject, it is stated that the tendency to sell electricity for general commercial use is constantly increasing among electric railway companies.

In 1902 there were 251 railway companies which furnished electricity for light, power and other purposes. These companies reported an aggregate income of $7,703,574 from the sale of energy. In 1907 there were 330 railway companies in this class, and the income from the sale of energy amounted to $20,093,302.

In 1902 the annual output of all electric stations and electric railways amounted to 4,768,535,512 kw-hours. In 1907 the output of the two classes of stations was 10,621,406,837 kw-hours, the increase in that year as compared with 1902 being 5,852,871,325 kw-hours, or 122.7 per cent. In 1902 the output by electric railways formed 47.4 per cent of the total, but by 1907 the proportion for such railways had fallen to 44.9 per cent.

Consolidations of the two branches of the industry and the growing tendency of the railway companies to sell electricity for commercial purposes are referred to in the report, which further states that the separate statistics of the central stations are, therefore, not representative of all the electrical energy sold for general commercial purposes. It is observed that during the five years ending with 1907 the central stations increased more rapidly than the electric railways.

Regarding the isolated plants, the report states that for the purpose of lighting and furnishing power for factories, hotels or other enterprises a large quantity of electricity is generated in plants which are operated for the exclusive benefit of their owners. Some of these plants sell limited amounts of energy, but they were established as adjuncts to other forms of business, and practically no statistics concerning them are included in the census reports. Some of these isolated plants are extensive and have a much larger capacity than many of the central stations. At the census of 1902 it was estimated that there were 50,000 of these isolated electric plants in the United States.

The number of commercial and municipal plants increased from 3620 in 1902 to 4714 in 1907, the increase amounting to 1094, or 30.2 per cent. The application of the same rate of increase to the estimated number of isolated plants in 1902 gives an estimate of 65,000 for 1907. To what extent the utilization of surplus power in the operation of private electric plants to furnish light and power for large mills, department stores, hotels and other industrial enterprises has stimulated the increase in these plants it is, the report declares, impossible to state, and notice is given that the estimate, therefore, may be more or less than the actual number of isolated plants in existence.

Referring to power or generating plants, the report states that the number of primary power or generating plants was not called for in the schedule used for reporting central stations in 1907, but some idea of their number may be had from the fact that the returns showed 4731 plants equipped with dynamos for the generation of electricity. Of the 4714 stations reported in 1907, 227 had no generating equipment, while 113 had more than one power plant. This latter class reported 357 generating stations.

There were, in 1907, according to the report, upward of 30,000 individuals, companies, corporations and municipalities, exclusive of isolated electric plants, which reported the generation or utilization of electric energy in what may be termed "commercial enterprises."

These industries represent an outstanding capitalization of $6,209,746,753, of which amount $1,367,338,836 is credited to central electric stations, $3,774,722,096 to electric railways, $814,616,004 to commercial or mutual telephone companies, and $253,019,817 to telegraph companies, the latter item including $32,726,242, the capital stock of wireless telegraph companies. The capitalization of the 17,702 independent farmer or rural telephone lines and of the 1157 electric police-patrol and fire-alarm systems could not be ascertained. The report states that there are also excluded a number of companies organized for the purpose of acquiring the capital stock or bonds of electric companies, street railway companies, gas and water systems, and similar properties, holding the same for investment and to some extent supervising the operation of the underlying companies; the reason being that to show the capitalization of these holding companies would be misleading as applied to central electric stations, since it would be impossible to determine the extent of its application to the electrical industry as distinguished from others.

The report states that the municipal stations are practically exempt from the consolidations that so frequently occur among commercial companies, and this fact no doubt accounts in large part for the proportionately greater increase discovered in the former class of stations. Not only was there a large increase in the number of municipal stations, but an analysis of the report shows that, although 33 municipal stations which reported in 1902 had become commercial stations in 1907, 113 stations which were reported as commercial in 1902 had become municipal in 1907.

The report refers to the fact that claim has been made, and sustained by what appears to be reasonable argument, that the drift of these public utilities is from municipal to commercial, but it is asserted that the results of the census do not furnish corroborative evidence of this. On the contrary, there appears to be a distinct field for municipal electric stations, not only because of the feeling which may exist in many localities that these public utilities should be owned by the cities, but because many of the places in which municipal plants are located do not present sufficient inducement for the investment of commercial capital.

Electric Railway Census Report.

The Bureau of the Census has issued a summary of its census of electric railways, taken in 1907. The full report, which is now on the press, was prepared under the supervision of Mr. William M. Steuart, chief statistician for manufacturers. Mr. T. Commerford Martin acted as consulting expert special agent and prepared the part of the report dealing with the technical features of the industry.

An interesting feature of the report is the comparative summary for 1907 and 1902, in which it is shown that the total number of operating and lessor companies in the United States in 1907 was 1236 and in 1902 987, the per cent of increase being 25.2. The operating companies in 1907 numbered 945 and

in 1902 817, an increase of 15.7 per cent. The lessor companies in 1907 numbered 291 and in 1902 170, the per cent of increase being 71.2.

In 1907 the total number of miles of line, by which is meant length of first main track or roadbed, was 25,547.19, as compared with 16,645.34 in 1902, the per cent of increase being 53.5. The total number of miles of track, meaning total length of all trackage, including sidings, 34,403.56 in 1907, as against 22,576.99 in 1902, the per cent of increase amounting to 52.4. Of the total number of miles of track, those operated by electricity in 1907 numbered 34,059.69 and in 1902 21,607.59. The per cent of increase was 55.5. The trackage operated by animal power in 1907 was 136.11 and in 1902 259.10. The per cent of decrease amounted to 47.5. The trackage operated by cable in 1907 was 61.71 and in 1902 240.69, the per cent of decrease being 74.4. The trackage operated by steam in 1907 was 146.05 and in 1902 169.61, a decrease of 13.9 per cent.

The cost of construction and equipment in 1907 was $3,637,668,708, as compared with $2,167,634,077 in 1902, the per cent of increase amounting to 67.8.

The number of employees in 1907 was 221,449, and in 1902 it was 140,769, the per cent of increase being 57.3.

The total number of cars in use in 1907 was 83,641, as against 66,784 in 1902, an increase of 25.2 per cent. The number of passenger cars in 1907 was 70,016, as compared with 60,290 in 1902. The per cent of increase was 16.1. The number of all other cars in 1907 was 13,615, and in 1902 it was 6494, the per cent of increase being 109.8.

The car mileage, including passenger, express, freight, mail, etc., in 1907 was 1,617,731,300, as compared with 1,144,430,466 in 1907, an increase of 41.4 per cent. In 1907 the number of power houses was 829, as against 805 in 1902, the increase representing 3 per cent.

The steam and gas engines and water-wheels used in generating the electricity were reported as having 2,476,479 hp in 1907, as compared with 1,349,211 in 1902, an increase of 1,127,268 hp, or 83.6 per cent.

The kilowatt capacity of dynamos in 1907 was 1,723,416, and in 1902 898,362, an increase of 91.8 per cent.

The gross income of the operating companies in 1907 was $429,744,254 and in 1902 it was $250,504,627, an increase of 71.6 per cent. The operating earnings in 1907 were $418,187,858, as compared with $247,553,999 in 1902, the increase being 68.9 per cent. The income from other sources in 1907 was $11,556,396, and in 1902 it was $2,950,628, an increase of 291.7 per cent.

The per cent ratio of operating expenses to operating earnings in 1907 was 60.1 and in 1902 it was 57.5.

The total capitalization outstanding of the operating and lessor companies in 1907 was $3,774,772,096, while in 1902 it was $2,308,282,099, an increase of 63.5 per cent.

The report observes that with few exceptions the percentages of increase are very uniform and indicate a large growth between 1902 and 1907. The unusual increase in the number of cars other than those for passengers is accounted for by the rapid development of freight business on interurban lines. The very large gain in the output of stations is due largely to the increasing practice among railway companies of operating electric light and power departments. The item of income from other sources than earnings from operation comprises interest and dividend on securities of other electric railways, income from other permanent investments, and income from miscellaneous sources, such as interest on deposits and rentals from real estate. The high percentage of increase in income from such sources reflects the extent to which electric railways have become connected with these miscellaneous interests.

The report states that, measured by trackage, the average operating company reported at the census of 1907 was about three and one-half times as large as the average company at the census of 1890.

It is noted that the average number of passenger cars per operating company was the same at the census of 1907 as that of 1902, this being a result of the general use of larger cars at the later census. The average number of "fare" passengers per car per year was 106,277 at the census of 1907, as compared with 79,187 for 1902 and 63,237 for 1890.

The percentage of total trackage operated by electric current increased from 15.5 in 1890 to 99 in 1907. Animal power was the most important in 1890, being in use on 69.7 per cent of the total trackage. By 1907, however, the proportion of trackage operated by animal power had decreased to four-tenths of 1 per cent.

Referring to the 945 operating companies, the report states that the use of electricity by line transmission was reported by 902 companies, with 34,034.19 miles of track. Electricity was one of the classes of energy used by every company employing more than one kind of energy. The electric railways owned or leased more than 65 per cent of the track used for horse cars, over 66 per cent of that operated by cable, and over 83 per cent of that operated by steam.

The greatest actual increase in the net trackage in any State was reported for Ohio, the next largest increase being in Indiana, Pennsylvania, California, Illinois and New York. The largest relative gain occurred in Idaho, when the track increased from 3.50 miles in 1902 to 73.09 miles in 1907, or 1988.3 per cent. The smallest actual increase, three miles, was reported by South Dakota, while the lowest rate of increase, 9.5 per cent, is shown for the District of Columbia and Montana. The large gains in the mileage of track in Ohio, Indiana, California and Illinois can be credited mainly to development of interurban lines, while the increases in Pennsylvania and New York are due to the growth of both urban and interurban lines.

The greatest absolute increase in the number of passengers carried was reported for the roads operating in the North Atlantic division of States, while the largest percentage of increase for the period 1902 to 1907 was for the South Central division.

The largest increase in the number of rides per inhabitant in 1907 was shown for the Western division, after which came the North Atlantic, North Central, South Atlantic and South Central in the order stated.

The amount reported in 1907 as cost of construction and equipment is more than nine times as great as in 1890 and over one and two-thirds as great as the total for 1902.

The income from passenger service formed 99 per cent of the total income from operation in 1890, but this proportion decreased to 94.5 per cent in 1902 and to 91.4 per cent in 1907. The percentage that the income from sources other than operation formed of the gross income was 1.2 per cent for both 1902 and 1890, and by 1907 it increased to 2.7 per cent.

The report states that a number of companies operating electric railways engaged also in other business, such as generation and sale of electric energy and the manufacture and sale of gas, ice, etc., while some carried on commercial enterprises and have investments in real estate and other property incident to the operation of railways. It is stated that bridge properties, canals, amusement parks and resorts, and turnpikes, which have been constructed or acquired by electric railway companies are, as a rule, covered by the capitalization of the railways, and statistics for them are included with those for the railways.

The contents of the report are in two parts. Part I pertains to the statistical phase of the subject and comprises a chapter on scope and method; another on comparisons with the censuses of 1902 and 1890; the third relates to power-plant equipment and output of stations; fourth, track and rolling stock; fifth, traffic; sixth, capitalization; seventh, financial operations; eighth, employees, salaries and wages; and ninth, sale of energy by electric railways. Part II concerns the technical side of the subject, and the first chapter covers equipment; the second, fares and transfers; third, use of electricity by steam railroads; fourth, interurban railways—economic, financial and social features; fifth, franchises, public regulation and public ownership; and sixth, foreign tramways and electric railways. There are 187 tables and 4 supplementary tables; also 2 ap-

pendixes, 3 maps and 7 diagrams. The illustrations in halftone are 30 in number and show overhead construction, third-rail coverings, underground stations and steel cars in tunnels, subway tunnel tracks, prepayment cars, side-rod electric locomotives, etc.

Block Signal Statistics.

On Jan. 1, 1910, according to the Block Signal and Train Control Board of the Interstate Commerce Commission, there were 65,758 miles of railroad in the United States operated under the block system. Of this mileage 14,237.7 was automatic and 51,520.3 was manual. For the year 1909 there was an increase of 2047.1 miles in the length of road covered by the automatic block system and an increase of 4162.2 miles in length of road covered by the manual system.

Classifying the kinds of automatic signals in use, exposed disks are used on 328.3 miles of road; enclosed disks on 1894.8 miles; electro-pneumatic semaphores, 419.1 miles; electric motor semaphores, 10,664.4 miles; electro-gas semaphores, 875.6 miles.

With the manual system the telegraph is used on 39,477.4 miles of road; telephone, 8105 miles; electric bells, 945.1 miles. Statistics of the controlled manual are as follows: No track circuit, 1909.5 miles; track circuit at stations, 385.8 miles; continuous track circuit, 491.5 miles. The electric train staff is used on 270.2 miles of road.

A Great Electric-Service System.

A firm of Chicago brokers familiar with electrical securities has issued a circular intended to interest general investors in the merits of the stock and bonds of the Commonwealth Edison Company of that city. The circular would not be issued, of course, if the condition of the company could not be set forth in a favorable light; nevertheless, the statements made are truthful, and the facts are presented in a concise and interesting manner. As of general interest to electrical readers the following references to the activities of a great central-station organization are condensed from this financial circular.

The capital stock of the Commonwealth Edison Company outstanding is $33,000,000 and the bonded indebtedness is $24,912,000. Thus nearly $58,000,000 is invested at this time in the generation and distribution of electrical energy from the central stations in Chicago. Six per cent dividends are paid on stock and 5 per cent interest on bonds. If the growth of the city and State in the years to come is considered, it is more than likely an investment of not $60,000,000, but double or triple that amount, will be needed to cover adequately the local field and to take care of the ever-increasing demands for electricity.

At frequent intervals the company has lowered the price for electricity, due to reduced cost of production. It may be mentioned that the income for the fiscal year ended Sept. 30, 1909, was, as regards the unit of energy sold, only 25 per cent per unit of the income received 13 years ago. This gives some idea of what has been accomplished by improved apparatus, concentration of production, success in selling and the greater volume of output. Compared with 13 years ago, the business is more profitable to-day on an income of only 25 per cent per unit sold of what it was at that time. The company's rates, taken all round, are now said to be lower than the rates in any other city in the world, and they will go still lower with the increasing demand for electricity, and with that increasing demand will come an ever-increasing revenue.

One great secret of the success of the Commonwealth company is its diversity factory. The total connected load in December, 1909, is given as 494,243 hp, divided as follows: Lighting, 199,429 hp; general power load, 149,774 hp; railway load, 145,040 hp. The financial men point out that the company supplies energy not only to nearly all the surface lines and elevated railways in the city and suburbs, but to several nearby towns by means of transmission lines to outside companies. Sixty per cent of the total energy sold by this company is in bulk at practically wholesale prices. Its service through the outside companies actually reaches a territory extending to a point 85 miles north of the center of Chicago and 55 miles south and to the west 35 miles; but its concentrated and general service covers an area of 200 sq. miles. Its franchises cover the entire city of Chicago, and as a result of this strong and logical position, no important extensions or enlargements of electric railway generating plants have been made in Chicago within the last five years.

A recent contract entered into with the Chicago City Railway Company, now the Chicago City & Connecting Railways Company, for all its energy, would seem to indicate that the company is able to underbid the railway companies at producing energy all along the line. This fact is of importance in view of the certainty of the electrification of the steam railway terminals within the city limits, at no very distant date. In all approximately 1250 miles, computing by single track, of street, elevated and underground railways are supplied with energy by this company.

American-Canadian Hydro-Electric Propositions.

Representing water-power interests on both sides of the Niagara River, Mr. Philip P. Barton, general manager of the Niagara Falls Power Company, and Mr. Corry, of Niagara Falls, N. Y., on June 7 conferred in Washington with Representative Alexander, of Buffalo, with regard to the drafting of a bill to be introduced in the House this session which will empower industries on the American side to increase the quantity of water in daily use for power purposes. Under the terms of the treaty negotiated last year with Canada a maximum limit of 20,000 cu. ft. per second is prescribed. Water-power users on the American side, however, say they have been compelled to keep within the limit of 16,600 cu. ft. provided by the Burton act, while the full quantity allowed has been utilized by concerns on the Canadian side of the river.

Following the meeting Mr. Alexander said it was his purpose to introduce before the close of the session a bill which will remove these restrictions and permit the increase of 3400 cu. ft. per second. There is believed to be little possibility of the passage of the measure at the present session. In explanation of the participation of the Canadian interests in the movement for the proposed legislation, it was stated that the question of energy transmission is involved.

Following the consideration by the Senate of the general dam act, action has been deferred on the recommendation made some weeks ago by the American Section of the International Waterways Commission with regard to the bill relating to the construction of a dam at the Long Sault rapids in the St. Lawrence River by American and Canadian capitalists interested in the St. Lawrence Power Company. The recommendations which were prepared following a meeting of the commissioners in Buffalo were submitted to the chief engineer of the War Department for report and forwarded by him to the Rivers and Harbors Committee. The nature of the report has not been made public, though the commission's recommendations were declared to virtually be a new bill.

At a meeting of the Dominion Privy Council at Ottawa, on June 7, an order in council was passed to authorize the Ontario & Minnesota Power Company to export to the United States a maximum of 3,500 hp of electrical energy, generated from damming the Rainy River at Fort Frances. The privilege is revokable at will by the Governor-General in council if the company neglects to comply with the conditions imposed from time to time. It is also stipulated that the price for power in Canada shall not exceed the price charged in the States for little quantities under similar circumstances.

The company gets this privilege after protracted negotiations. Its application to the Federal Government was heard by a committee of the Cabinet several weeks ago, but no action was taken until it settled with the Ontario Government some points

in dispute, which arose over some properties controlled by the Provincial Government which the company needed for development purposes. Finally an agreement was reached upon which the Federal Government took action. The company wanted the right to export 6000 hp, but the quantity was cut nearly in half by the Canadian cabinet.

On the joint invitation of the Hydroelectric and Niagara Falls Park Commissioners, a party of newspaper men inspected the property at Niagara Falls, Ontario, on June 5. In company with Hon. Adam Beck, chairman of the Power Commission; Mr. P. W. Ellis, member, and P. W. Sothman, chief engineer, of the commission, the party traversed the transmission line from Toronto to the Falls, being taken in charge by Park Commissioners Ellis and Col. L. Clarke Raymond on their arrival there. At the Falls, Messrs. P. N. Nunn and V. G. Converse, of the Ontario Power Company, engineers in charge, conducted the party over the entire plant, now capable of generating 100,000 hp. The transmission lines from the Falls to Toronto and from the Falls to Berlin are almost completed and it is expected that Berlin will be the first city to receive and utilize Niagara power.

Concentration of Public-Service Utilities in Northern Illinois.

The nation-wide tendency toward the centralization of the electric-service industry in strong and extensive systems, supplementing a much larger number of small plants, or comparatively small plants, is nowhere better exemplified than in northern Illinois. This fact is brought to attention at the present time by the organization of the Illinois Valley Gas & Electric Company which, with its main operating office at Streator, Ill., will operate gas, electric-service, and electric-railway plants in several counties in the northeastern part of the State. Mr. Samuel Insull, of Chicago, is president of this company, and he is also president of the Commonwealth Edison Company of Chicago, the North Shore Electric Company, with headquarters in Chicago and operating in the suburban belt around the city, and the Economy Light & Power Company, with main operating office in Joliet. These four companies are in sympathy with one another and work in unison. Each one (excepting, possibly, the Economy Company) represents the consolidation of a large number of small and scattered plants.

Officers have been elected by the new Illinois Valley Gas & Electric Company as follows: President, Mr. Samuel Insull; vice-president, Mr. Charles A. Munroe; secretary and treasurer, Mr. John H. Gulick. The list of plants acquired by the new company includes the properties of the United Electric Company, of Morris and Seneca; the Morris Gas Light Company, the Ottawa Gas Light & Coke Company, the Illinois Light & Traction Company, of Streator (which operates the local street-railway system); the Odell Electric Light Company, the Dwight Electric Light Plant, the Gardner Electric Light Plant, the Wilmington Light & Power Company, and others.

Beginning business about June 1 the Illinois Valley Gas & Electric Company, incorporated under the laws of the State of Illinois, has an authorized capital stock of $6,250,000, divided into $3,000,000 preferred stock and $3,250,000 common stock. The company is authorized to issue bonds to the amount of $10,000,000. However, the initial issue of securities will be as follows: Preferred stock, $500,000; common stock, $3,250,000; bonds, $750,000 (to be a first-mortgage lien and bearing interest at 5 per cent). The preferred stock carries 6 per cent dividend.

The company operates in Will, Grundy, La Salle and Livingston Counties. Its territory adjoins that of the Economy Company, of Joliet, and the relations of the two companies will no doubt be close. In almost all cases the franchises of the public utilities secured were granted for a duration of 50 years. It is probable that the Illinois Valley company will obtain at least a considerable proportion of its electrical energy from the Joliet water-power plant of the Economy Company. The new company has itself a small hydroelectric plant on the Kankakee River at Wilmington, and this plant will be maintained. The small existing steam-generating plants will gradually be abandoned and a transmission and distribution system will be built up, with Streator as the center of distribution. It is also proposed to erect a steam-generating station of modern design at Streator to supplement the supply of electricity obtained from water-power plants. This generating station will be modern in every respect, and the designs are in the hands of Sargent & Lundy, of Chicago.

In relation to its gas business the company expects to extend this branch of its service by the use of high-pressure mains extending from Streator or other places where it may be decided to continue the manufacture of gas.

It is interesting to know that the financial men who are promoting the sale of the new securities of the new company have ascertained that the combined net earnings of the previous separate companies now combined in the Illinois Valley Gas & Electric Company, operated under independent managements in 1909, were $71,141.27, which is more than sufficient to pay the interest on the bonds and the 6 per cent dividend on the preferred stock of the initial issue. It is estimated that the gross earnings of the company in 1911 will be $342,000, with operating expenses of $198,000 and net earnings of $144,000. It is also believed that the net earnings will increase, year by year, and it is expected that this amount in 1913, for instance, will be about $212,000.

Report on Telephone Cost in Chicago to Be Analyzed.

The notable report to the city comptroller of Chicago on the cost of telephone service given by the Chicago Telephone Company, made by Messrs D. C. and W. C. Jackson, engineers, and Arthur Young & Company, certified accountants, and summarized in these columns in the issue of May 19 (page 1243), continues to be the subject of discussion. This report, which goes into the subject of depreciation in an unflinching manner, shows that at the present rates for telephone service, with what the authors consider proper allowance for depreciation, and after paying 5 per cent on bonds and 8 per cent on stock, the Chicago Telephone Company really faced a deficit of over $900,000 as a result of operations for the year ended March 31, 1910.

The comptroller submitted the report to the City Council, which in turn referred it to the council committee on gas, oil and electric light. A sub-committee, consisting of Aldermen Pringle, Long and Merriam, has now recommended that the Jackson-Young report be gone over by other experts acting under the direction of the committee, and be checked up in connection with data at hand, or which can be secured, bearing on the case. The employment of the services of an expert accountant and such engineering and other advice as may be necessary to examine the report thoroughly is provided at an estimated cost of from $5,000 to $10,000. The question of the city making a complete inventory of the physical property of the Chicago Telephone Company is to be held in abeyance until the work of the second set of experts passing on the Jackson-Young report shall have been finished.

The question of revising telephone rates in Chicago is now up for settlement, and the city officials seem to think that the position of the company under existing rates is not quite so desperate as the Jackson-Young report would seem to indicate. The expert retained, or at least one of them, is Mr. W. J. Hagenah, of Madison, Wis., who was appointed by the sub-committee on June 10. Mr. Hagenah has been statistician for the Wisconsin Railroad Commission during the last three years, and is author of the accounting system of that body. He is a graduate of the University of Wisconsin and the University of Wisconsin Law School. He has had considerable experience in public-utility matters and especially in matters of rate making, and was formerly assistant commissioner of labor for the State of Wisconsin. Mr. Hagenah, who was recommended by the Wisconsin Railroad Commission, will have the opportunity of advising and consulting with the commission and will have the benefit of statistical data in the office of the commission at Madison. He will begin his work in Chicago on June 20.

Tantalum Lamps for Chicago Railway Cars.

The Chicago Railways Company, during the past six months, has made extensive tests of tantalum lamps for use in street cars. These tests were performed by equipping regularly operated cars with sample lamps and keeping accurate records of the car-miles, lamp-hours, voltage and replacements. Within the past few weeks all the cars on the Van Buren Street line, which are of the large pay-as-you-enter type, have been equipped with tantalum lamps. Different makes of lamps are being tried on other cars and if the results of the present tests are satisfactory the installation of tantalum lamps on all new and rebuilt cars of the Chicago Railways Company will be permanent.

The new pay-as-you-enter cars of the Chicago Railways Company are illuminated with a row of nine 16-cp lamps on each side of the car and three 32-cp lamps spaced along the center line of the upper deck. The circuit of the side lamps includes a 16-cp lamp in an illuminated destination sign box. Each circuit of the 32-cp lamps includes a headlight lamp and a lamp over the conductor's head on the rear platform. Three forms of tantalum lamps are used in equipping each car. The lamp used in the headlight is a 32-40-cp, 70-watt tantalum with an extra small bulb; the platform and center lamps are 32-cp, 70-watt tantalums, and the side and sign lamps are 16-cp, 35-watt tantalums. Several different forms of filament winding are under consideration with a view to obtaining a lamp with low breakage. Various arrangements of frosting on the bulbs have been tried and discarded in favor of clear glass. It has not been found practical to place tantalum lamps on some of the older cars having center fixtures, which hold the lamps at an angle greater than 15 deg. with the vertical.

Toronto Central-Station Situation.

In view of the contract made by the city of Toronto with the Hydroelectric Commission for the transmission of a large quantity of energy from Niagara Falls to that city, and in order to obviate competition by the city with its commercial business, the Toronto Electric Light Company has submitted a proposition for the division of electrical supply in the city. In a letter to the city authorities, Sir Henry M. Pellatt, president of the Toronto Electric Light Company, proposes that the city shall utilize the energy supplied by the Hydroelectric Commission only for its water-works pumping stations, street lighting and motors, and for lighting the municipal buildings. In return the electric light company would give the city the use of its poles for street-lighting and motor circuits, erect such new pole lines as may be required by the city for these purposes and take off the city's hands the poles it has already purchased. Space in the present underground conduits of the lighting company would also be rented to the city, and such new conduits constructed as the municipal system may require. The proposal also includes a reciprocal arrangement to supply electrical energy each to the other in case of emergency or shortage, and for the lighting company to take over any quantity of energy which the city has contracted to take from the commission and which would not be used for the above mentioned municipal purposes.

It is also proposed that a new schedule of rates be formulated on a basis providing for operating expenses and fixed charges, dividends at the rate of 10 per cent per annum on the capital stock, and a reasonable allowance for depreciation and other necessary reserve funds, any surplus above these requirements to be applied to the reduction of rates to consumers. It is further provided that the Mayor shall be an ex-officio member of the board of directors of the electric light company, and that all matters in dispute are to be settled by arbitration.

It is pointed out that the acceptance of this proposal would mean that the present desirable arrangement between the city and the gas company would be extended to the electric light company, and at the same time there would be no conflict whatever in relation to the contract of the city to take energy from the Hydroelectric Commission. The direct advantages that would accrue to the city from an acceptance of the above proposition are that the rates for electrical energy to consumers would be less than ever could be granted under competition, and would not be greater than those now proposed by the city's electrical department; a capital expenditure by the city of at least $5,000,000 would be saved, and the duplication of underground conduits and of poles and wires throughout the city would be avoided, while the overhead construction of the main business streets of the city would be gradually removed. Moreover, there would be a second system working interchangeably with that of the company, but practically in reverse, which would insure continuous service of electrical energy free from any interruptions.

Outlet Box Patent Litigation.

The United States Circuit Court of Appeals for the Second District (New York) has rendered a decision upholding a patent issued July 21, 1896, to Mr. William F. Bossert on outlet boxes for interior conduit distribution.

In discussing the state of the art, the court referred in detail to the development of "knockout" boxes. In 1899 a box was installed in the house of Mr. William Rockefeller at Tarrytown, N. Y., made of thin galvanized iron in which holes had been punched and then filled by reinserting the part punched out and keeping it in place by tacks of solder. In 1890 a box was put in the Dunshee Apartment House of thin brass out of which disks had been partially cut and held in place by two uncut connections with the wall of the box. Other boxes were made of iron cast thinner at points, where holes could be opened by breaking the wall, or with holes closed by plugs like the ordinary stovepipe hole cover which could be drawn out, or holes covered by sheets of stiff paper or thin metal which could be easily broken through at desired points. Others had holes filled by ordinary plugs of cork or rubber which could be pulled out or caps which could be unscrewed.

The court held that Bossert's invention consisted in his applying in 1896 to the well-known universal knockout box the old punching process. That is to say, he made a box of ductile metal of sufficient thickness and then, by the use of dies, punched out disks where holes were wanted and drove the disks back into their original places. This made an integral box in which orifices could be opened by driving out the disks. The punching process had never been applied to a universal knockout box and during the seven or more years in which the trade was making these boxes no one thought of making them in this way until Bossert did. The judge of the lower court found that in this way Bossert produced a box so superior in all respects as to displace all others.

As to the question whether the Bossert improvement was the result of mere mechanical skill or involved the higher quality of invention, it was held that the judge of the Circuit Court rightly decided that invention was involved.

In conclusion the court held that, although the defendant's plugs may be knocked out in either direction, they may be driven one way with a single blow of the hammer, while it requires several blows to drive them the other way. It is argued that for this reason they do not infringe, because in a letter of the patentee's to the Patent Office he states that the plugs might be removed either way with equal facility. No such limitation is found in the claim nor is there anything in the prior art which requires such limitation. The mere statement in the letter implies no more than that the plugs may be knocked either in or out without breaking the box or disorganizing the device, whichever way is selected.

The defendant's plugs are not flush with the walls, but they are punched out of the metal and then forced back. A small tongue or ear integral with the wall remains when a plug is punched, but the plug is thereafter forced back into place and is there retained by wedging in the opening, although the ear contributes in some slight degree to keep it there. The court, therefore, held that infringement of the fifth claim of the Bossert patent of July 21, 1896, was proved.

Convention of National Electrical Credit Association.

Considerable business was transacted at the eleventh annual meeting of the National Electrical Credit Association, formerly the National Electrical Trades Association, at the Clifton Hotel, Niagara Falls, Ont., on June 9. This meeting was announced to be held in San Francisco, but it was decided to change the place of meeting shortly before the gathering took place. There were in attendance representatives of the New England Electrical Credit Association, the Electrical Credit Society of New York, the Electrical Credit Association of Philadelphia, the Electrical Credit Association of Chicago and the Electrical Credit Association of the Pacific Coast.

The reports indicated that the association had passed through a year of substantial growth and gratifying accomplishments. The total number of items handled by the association since its establishment is 50,671, while the total amount of settlements adjusted is $2,603,628.72. The membership of the national association now numbers 431 of the representative manufacturers and jobbers in the electrical trade, from the Atlantic to the Pacific and from the Lakes to the Gulf.

Officers were elected for the ensuing year as follows: President, Mr. Chas. C. Hillis, Electric Appliance Company, San Francisco; vice-president, Mr. A. L. Miller, John A. Roebling's Sons Company, New York; secretary and treasurer, Mr. Frederic P. Vose, Chicago. San Francisco was selected as the place of the next annual meeting, to be held June 8, 1911.

Railway Electrical Engineers at Buffalo.

The spring semi-annual convention of the Association of Railway Electrical Engineers, formerly the Association of Car-Lighting Engineers, was held at the Statler Hotel, Buffalo, N. Y., June 7 and 8. About 15 steam railroads were represented. The meeting was held for the purpose of reviewing and discussing the work of the committees and the progress made during the six months since the last convention in October, 1909.

Among the important business matters transacted by the convention was the adoption of the Gibbs train connector as standard for establishing electrical connections from car to car. The Pullman Company has already equipped most of its cars with this type of connector and many of the railroad companies are preparing to fit out their cars uniform with the standard practice.

At one of the sessions, the members also took up the matter of changing 110-volt head-end train-lighting systems to 64 volts. The latter potential is believed to be sufficient for good service and will permit of the use of fewer cells. The change from 110 volts to 64 volts was generally approved by the engineers present.

The experience of the members also brought out the fact that the 30-volt tungsten train-lighting lamp is a thorough commercial success, and is being used to advantage with the 30-volt axle lighting equipment.

In common with other railroad departments and other electrical industries the electrical engineers of the steam railroads appreciate the necessity for a uniform system of accounting and record-keeping. In recording the cost accounts of axle-lighting systems on different roads, it is the practice of some superintendents to add in charges on the repair machinery and shop equipment, while others include only the actual cost of new material entering into the job. In order to secure a uniform system by which it will be possible to compare the cost of repairs and maintenance on the roads of the members of the association, a committee has been appointed to formulate an approved method of cost records.

The sessions of the Association of Railway Electrical Engineers were presided over by President E. M. Cutting, electrical engineer of the Southern Pacific Railroad. Mr. George B. Colegrove, of the Illinois Central Railway, Chicago, is secretary and treasurer of the organization.

National Electric Vehicle Association.

For the purpose of discussing the organization of a National Electric Vehicle Association, a well-attended meeting was held in the office of Mr. Arthur Williams, of the New York Edison Company, on June 8. Representatives of all the local electric light companies were in attendance, as well as of the various electric-vehicle manufacturers and storage-battery makers. The object of the proposed association is understood to be co-operation in an endeavor to increase public interest in the electric vehicle as an economical transportation proposition. While it has been demonstrated that the electric vehicle is a practical and economical substitute for the horse-drawn vehicle, this fact is not generally recognized or understood, and one of the objects of the association is to help the user to a better understanding of the machine. The following were appointed as members of a plan and scope committee: Mr. W. H. Blood, Jr., of Stone & Webster, Boston, Mass., chairman; Messrs. Charles Blizard, of the Electric Storage Battery Company; Hayden Eames, of the Studebaker Company; Frank J. Stone, of the Electric Storage Battery Company; F. L. Dyer, of the Edison Storage Battery Company; H. H. Rice, of the Waverley Company; H. C. Cushing, of *Central Station;* P. D. Wagoner, of the General Vehicle Company; W. W. Freeman, of the Edison Electric Illuminating Company, of Brooklyn; C. G. M. Thomas, of the New York & Queens Electric Light & Power Company, and Harvey Robinson, of the New York Edison Company. Those in attendance in addition to the committee above mentioned were Messrs. Thomas A. Edison, John Kelly and C. D. Marsh, of the Edison Storage Battery Company; N. F. Brady, T. E. Murray, C. S. Shepard and Arthur Williams, of the New York Edison Company; W. P. Kennedy, G. W. Hill and J. H. Hill, of the Studebaker Company; C. L. Morgan and L. Ruprecht, of the General Vehicle Company; P. Dumont and A. G. Brown, of the Baker Vehicle Company; J. Kinsey, of the Lansden Company; H. Greene, of the Couple Gear Company; A. Taylor, of the Electric Storage Battery Company; George Hayes and W. Dowd, of the Gould Storage Battery Company; J. F. Becker, of the United Electric Light & Power Company, and W. L. Secord and W. D. Jones, of the Westchester Lighting Company. It is expected that the new society will complete its organization early in the fall.

St. Louis Convention in Review.

Mr. H. B. Gear, general inspector for the Commonwealth Edison Company, reviewed the recent St. Louis convention of the National Electric Light Association for the benefit of the members of the Electric Club of Chicago at the meeting of that organization on June 8. Remarking that he could only touch the "high spots" of the convention, Mr. Gear gave a clear 20-minute exposition of the more important features of the gathering. He spoke of the exhibition as one of the most valuable features of the convention, giving, as it does, the operating man an opportunity to inspect the new appliances of the year.

The clever paper of Mr. Paul Lupke on "Super-Specialization" was praised, and also Mr. C. F. Scott's paper on "A New Form of Tungsten Lamp." Referring to this type of illuminant, Mr. Gear said that it was apparently the coming lamp. Mr. S. E. Doane's paper on "High-Efficiency Lamps" was commented on favorably, and the reports, and in some cases exhibits, of the committees on progress, meters, overhead line construction, preservative treatment of wood, lightning protection and grounding of secondaries were mentioned briefly. Dwelling for a moment on the grounding of secondaries, the speaker remarked that this practice is much more common now than formerly. The rule now is that the grounding of secondaries up to 150 volts shall be mandatory, and optional between 150 volts and 250 volts.

Mr. H. L. Doherty's address on "Water-Powers" and the animated discussion that followed it were referred to. Brief comment was devoted to the exhibit of the committee on uni-

form accounting, in 24 volumes, and consisting of about 10,000 blanks and forms. The accounting-session paper of Messrs. George A. McKana and D. F. Maguire came in for a word of praise, while among the commercial papers particular reference was made to Mr. A. S. Huey's contribution on central-station commercialism and Mr. Hayden Eames' excellent paper on "The Electric Vehicle Opportunity." Appreciative mention was made of the company section meeting, but perhaps the most important feature of the convention was the anniversary meeting on the evening of May 25. Mr. E. A. Sperry's interesting paper on "The Founding of the Association," Mr. Samuel Insull's stimulating address on "Twenty-five Years of Central-Station Commercial Development," and the valuable report of the public-policy committee were briefly summarized.

Mr. H. E. Niesz presided at the meeting, and at his request Mr. W. E. Keily gave a brief account of the work done on the *Convention Daily* by the electrical press. Mr. A. A. Gray pointed out the conspicuous part taken in the convention by representatives of the Commonwealth Edison Company and the other electrical interests of Chicago. A vote of thanks was extended to Mr. Gear for his instructive address.

Photometric Units.

Dr. E. B. Rosa presented a paper at a meeting of the New York Section of the Illuminating Engineering Society, on June 9, giving an outline of the relations between various photometric units. The author stated that the luminous flux density in space is analogous to electric displacement in electrostatics, and the illumination on a material surface is analogous to surface density of electric charge. One thinks of an electric displacement as occurring everywhere in space about an electric charge, but a surface density occurs only where there is a material conducting body on which the lines of electric force terminate. In the same way the terms luminous flux and flux density apply generally. The *radiation* is the flux density at the source of the flux, and the *illumination* is the flux density or flux per unit of area on the surface where the luminous flux is received.

Luminous flux is recognized as the physical stimulus which applied to the retina produces the sensation of light. It is equal to the radiant power multiplied by the stimulus coefficient. This stimulus coefficient is different for every different wave frequency or wave length; it is a maximum in the yellow-green region, and is zero for all frequencies outside the visible spectrum. By measuring the electrical power input in watts and the spherical candle-power output in lumens one can determine the ratio of the luminous flux to the radiant power in any particular case. One may properly say that luminous flux is due to and is always associated with radiant power measured in watts. However, the statement sometimes made that luminous flux and radiant power can be converted into one another like feet and inches is misleading; for the conversion factor, the stimulus coefficient or luminous efficiency, is not a constant like the ratio of feet to inches, but is variable, having a different value for every different wave length in the visible spectrum and falling to zero outside the visible spectrum.

The author showed that in the case of a circular disk source of light, the illumination on a small plane normal to the axis is proportional to the total quantity of light on the extended disk source and inversely proportional to the square of the distance from the plane to the edge of disk. This relation holds true for all distances from zero to infinity. Thus the law of inverse squares holds generally for the illumination along its axis due to a circular disk of any size, but the distance must be measured, not to the center of the disk, but to its edge.

In the case of an infinite plane the flux density is the same at all points in space quite independent of the distance from the plane. The illumination due to an infinite cylinder varies inversely as the distance, while the illumination produced by a short cylinder is approximately inversely proportional to the square of the distance.

The illumination produced by a sphere of any size is inversely proportional to the square of the distance measured from its center, and is equal to the intensity of a point source having the same total amount of light divided by the square of the distance. In other words, the inverse square law holds just as rigorously for large spheres as for points, assuming the cosine law to hold for the spherical surfaces, and the specific intensity to be uniform over the sphere. In the case of a hollow sphere having a uniform coefficient of diffuse reflection, receiving light from a source within, every interior surface element illuminates all other elements equally. Therefore, the indirect illumination of the sphere must be the same everywhere, no matter how unequal the direct illumination may be. That is, a lamp within may illuminate the sphere unequally, directly, but that part of the total illumination due to diffuse reflection is, notwithstanding, equal everywhere. In calculating the illumination within such a sphere the author showed that with a coefficient of diffuse reflection of 0.8, the total illumination is five times what it would be if the walls were perfectly black, there being required to supply just enough illumination to cover the constant loss by absorption.

A small disk placed at any point within a uniformly illuminated hollow sphere will receive the same flux whatever may be the orientation of the disk. Within this sphere the flux is everywhere uniform and equal and it has no resultant direction. Within a cube or enclosure of any shape, of which the walls have a uniform brightness, the same condition obtains as in the sphere; namely, the luminous flux is everywhere the same, and a small area will have the same illumination no matter where it is placed or how it is oriented. The same is also true for the space within two infinite planes of equal uniform brightness, the illumination on a small plane anywhere between the two radiating planes being of equal value no matter how they are placed.

DISCUSSION.

Mr. V. R. Lansingh called attention to the fact that the quantities dealt with and defined by Dr. Rose are physical rather than physiological, while the latter should not be ignored in illumination problems. He mentioned two non-physical relations that must always be taken into consideration, namely, the "efficiency of the eye" and "visual efficiency." The former takes account of the effects associated with glare and the latter relates to the ability to distinguish objects by reason of contrast, etc. In regard to glare it is to be noted that the effect is physiologically a local retinal disturbance which, when sufficiently separated on the retina from the disturbance produced by the visualized object, does not extend to or affect the latter area of disturbance. Observations made by Mr. A. J. Sweet showed that when the angle of separation exceeds about 26 deg. the glare effect reaches zero, although the light source may be well within the field of vision.

Dr. C. H. Sharp claimed that what Mr. Lansingh had defined as "visual efficiency" should be termed "physiological efficiency." The ability of the eye to observe objects depends not only on the density of illumination on the object viewed, but largely on the brilliance of the illumination of surrounding objects. That the adjustment of the pupil for the higher illumination is not the sole cause for the inability to see objects faintly illuminated when brilliantly illuminated objects are within the field of vision, is shown by the instant disappearance from view of moonlight scenes witnessed through a window from a darkened room when the room is suddenly lighted. The transformation from darkness to light in the room and the disappearance of the external view are instantaneous, while the pupilary contraction requires an appreciable interval of time.

Dr. Sharp said that much misinformation relating to the spherical reduction factor of incandescent lamps has been disseminated by reason of the assumption that, since the spherical reduction factor of a short cylinder is $\pi \div 4 = 0.785$, the same value applies approximately to all types of incandescent lamps. The fact of the matter is that the value ranges from 0.7 to almost 2.0.

Selection of Electric Railway Apparatus.

The electrification of steam-railroad service was discussed at a meeting of the Electrical Section of the Western Society of Engineers, Chicago, Tuesday evening, June 7, at which Mr. Frederick Darlington, of the Westinghouse Electric & Manufacturing Company, Pittsburgh, read an abstract of his paper entitled "Economic Considerations Governing the Selection of Electric Railroad Apparatus." An abstract of this paper was given in the *Electrical World* of June 9.

In opening the discussion, Mr. G. T. Seely, of the South Side Elevated Railroad Company, Chicago, who presided, remarked that when his road adopted electricity in 1896 it was burning anthracite at an average cost of from $4 to $4.50 a ton. With the substitution of electric energy, the cost of the cheaper coal which could be used to advantage in the power house did not exceed $1.50 per ton, while the total amount burned was less than that previously fired in the locomotives. As the result of this early electrification, the cost per car-mile was reduced by one-third.

Remarking that there is only one electric railway company in Cook County which does not purchase all or part of its energy for operating its cars from the Commonwealth Edison Company of Chicago, Mr. Seely called upon Mr. W. L. Abbott, chief operating engineer of that company. Mr. Abbott observed that electrification of main lines and terminals is a matter to be reckoned with by steam railroads in the near future. He also pointed out that the generation of energy in a central station permits the use of cheaper grades of coal, and in some instances may avoid the necessity for the steam road's hauling its own coal. These savings, he felt, might represent the difference between operation at a profit and operation at a loss, in the straitened condition in which many railroads find themselves to-day.

Mr. W. B. Jackson, consulting engineer, Chicago, called attention to the successful operation of several three-phase roads with which he is acquainted, and predicted that the last word has not yet been said on the subject of three-phase electrification. The three-phase system offers the same advantages of transmission and transformation as does the single-phase, he said, possessing the additional advantages of regenerative control and braking. For long-distance electrifications, said Mr. Jackson, three-phase electrification may yet work in to a greater extent than seems to be the present general opinion.

Mr. A. P. Jenks, of the General Electric Company, Chicago, took exception to some of the remarks by the author of the paper in comparing direct-current with single-phase electrification costs. For short roads giving frequent service he felt that 600-volt, direct-current operation would show up more favorably than single-phase; while for the interurban of average length he asserted that 1200-volt direct current is as economical as 6600-volt single-phase. Mr. Jenks said that the cheaper operation secured by avoiding rotary-converter substations with their attendants was offset by the higher maintenance of alternating-current systems, at least in the case of reports which he had recently examined. High-voltage direct current has the advantage of lower first cost compared with the single-phase, he remarked, and is equal in all respects for interurban service. For trunk-line work, he suggested that even higher direct-current voltages might be developed, as the result of which, operation may be secured the equal of anything accomplished by alternating-current electrification. Mr. Jenks also called attention to the importance of standardization of railway equipment, pointing out that the 600-volt and 1200-volt systems closely approximate familiar electric railway practice.

Mr. A. Bement, consulting engineer, Chicago, referred to the public's appreciation, amounting almost to discrimination, in favor of electric service where electric railways parallel steam roads. As an example, he referred to the condition at San Francisco, where steam railroads and electric railways are in competition, each having ferry lines across San Francisco Bay. By far the larger proportion of the traffic prefers the electric line, although the fare and frequency of service are precisely identical. Mr. Bement suggested that this "appreciability factor," as he termed it, in favor of electric service as compared with steam lines, might well be determined numerically, as it is an important factor in predicting the traffic which an electric railway will draw.

Mr. E. N. Lake, of the Board of Supervising Engineers, Chicago Traction, declared that the two important points of standardization and interchange had not received adequate attention in the paper. He remarked the large number of different voltages, frequencies and constructions employed in present single-phase practice, and declared that some standard specification would have to be determined upon before universal electrification of railroads could be hoped for. In the case of a wholly new design, he inquired of the author of the paper what voltage, frequency and construction would be employed for the best operation?

At this point, Mr. Seely, from the chair, suggested that the great advance of the art of railway electrification is doubtless due in a large measure to the warm competition existing between advocates of different systems. Mr. G. H. Lukes, general superintendent of the North Shore Electric Company, remarked the change shown in a few years by the papers read before the Western Society of Engineers, indicating the advance from considering electrification as suitable only for limited conditions to the present broad appreciation of electric systems as applicable anywhere in ordinary steam-railroad service.

Mr. Clarence Renshaw, of the Westinghouse Company, Pittsburgh, reasserted the point of the present availability of electrification for all kinds of steam-railroad services—terminals tunnels and trunk lines. The complications of the three-phase distribution system, he thought, present serious objections to that system. In answer to Mr. Lake's inquiry for a standard specification, he suggested that an 11,000-volt, 15-cycle, single-phase, alternating-current system could be taken at once as an absolute standard of electrification for the future development of railroad work. He added that 25-cycle, 11,000-volt electrification would also be entirely suitable for the service, and that every road in the country might be electrified in uniformity with the New Haven installation, handling successfully all kinds of service. Mr. Renshaw then compared the large difference in transmission losses between high-voltage, alternating-current distribution lines, and the lower voltages available with direct-current trolley. The New Haven electrification, he remarked, is in fact the only example of real trunk-line electrification, besides being the only one which has so satisfied the management that further extensions of the system have been approved. The New Haven Company is now experimenting with two types of freight locomotives. With the higher voltage available with the single-phase system, said Mr. Renshaw, one unit in the power house can cover a greater section of track than with the low-voltage, direct-current systems, thus, from the diversity of demand, securing a more uniform loading of the machine. The alternating-current, single-phase system, he declared, is the only one that is entirely suitable for handling both suburban and through-train service. As no 1200-volt railroad line is at present in operation, he felt that there is as yet little basis in the way of actual examples for a discussion on this point. The first single-phase line to go into use—that of the Indianapolis & Cincinnati Traction Company—has secured maintenance records showing a cost of ¾ cent per car mile, a figure which Mr. Renshaw declared was much lower than several examples of 600-volt, direct-current electrification he had examined.

In answer to questions, Mr. Darlington, author of the paper, gave the information that the power factor in the case of the New Haven electrification is between 80 and 85 per cent; probably not as good, he said, as it might have been had 15 cycles been used. The use of a copper working trolley is thoroughly satisfactory, he said, for speeds under 60 miles an hour. Mr. Darlington again reminded his audience that his paper undertook only the comparison of the present systems of electrifications as applied to heavy railroad service, and that in his re-

marks he had thus far undertaken to discuss not future possibilities, but the present accomplishments with these systems. In an interesting prediction of the future of transportation in Illinois, Mr. Darlington remarked that the electrified railroads would purchase their energy from three or four large central power houses operated by companies which would make a business of selling energy for this purpose, thus doing away with the present low load factors encountered in electric railway power generation. At the present time, the three-phase system does not meet thoroughly satisfactorily all conditions of speed control, said Mr. Darlington, and he reminded Mr. Jackson that in one of the installations of which the latter had spoken earlier in the evening two motors are employed in the car, one being used for each of two of the three efficient speeds, and the two motors being operated in cascade for the third efficient speed. Such a scheme entails carrying non-productive motor equipment throughout a large proportion of the car travel. Mr. Darlington objected also to the point previously made that a three-phase transformer can be built more cheaply as the equivalent rating in single-phase apparatus.

The Electric Vehicle.

The last meeting of the Electric Vehicle and Central-Station Association for the present season was held in Boston at the Edison Building on the evening of June 9, with President William H. Blood, Jr., in the chair. In the absence of a formal program a number of central-station managers gave short addresses on the possibilities of the electric vehicle in their respective cities, discussing the subject with the idea of pointing out the weak spots in the electric vehicle movement. Before the discussion began Past-President F. J. Stone, of the association, reviewed the work of the executive committee of the organization in connection with recent plans to establish a national association with local branches. On June 8 a meeting was held in New York for the consideration of this matter, a report of which appears elsewhere. The name of the new organization has not been fully determined as yet, but the most favored title seems to be "The Electric Vehicle Association of America." The association members at Boston voted to empower their executive committee with full authority to act on behalf of a merger with a national association.

In opening the discussion President Blood referred in cordial terms to the paper of Mr. Hayden Eames before the National Electric Light Association at St. Louis on "The Electric Vehicle Opportunity," quoting several extracts relating to the outlook for the future and the commercial side of the business. He cited instances of ignorance of electric vehicle progress existing among even prominent officials and emphasized the value of an educational campaign by the association. Mr. E. S. Mansfield, of the Edison Electric Illuminating Company, Boston, stated that 20 years ago few would have believed that the present electric vehicle movement would be a possibility. The central stations are not asleep, as the manufacturers sometimes imply. Boston has always been a pioneer in electrical applications, but an unfortunate experience about 10 years ago with imperfect and undeveloped apparatus has resulted in a large amount of conservatism in the local community. The present mileage is limited by the congestion of the business streets, and other adverse factors are the condition of the pavements and the relatively limited mileage of batteries. The electric vehicle helps to reduce the congestion of streets, and the tendency toward asphalt pavements is helpful. The battery situation is being improved by the establishment of more charging stations. It is important that the electric vehicle shall stick to its own proper field of handling continuous and substantial loads at moderate speeds. The gasoline car is better adapted to high speed, long-distance service. On the Boston wharves gasoline cars are excluded, and horse-drawn vehicles are cumbersome and slow. The electric vehicle has a good chance to make itself useful here, notably in the express, coal, banking, paper stock and newspaper fields. The excellent suburban roads around Boston furnish ideal conditions for pleasure-vehicle operation.

Taking up the question of central-station rates for electric vehicle charging, Mr. Mansfield showed how the average rate per kw-hour has actually worked out in a number of cases on the Boston Edison system. These are given in the following table:

Service	Capacity Charge Equipm't, Watts	Demand, KW	KW-Hours per Month	Monthly Bill	Average Price KW-Hour
1 Doctor.....	3,390	1.2	32	$3.52	11 cts.
2 Residence....	4,000	1.6	90	9.14	10.1
3 Suburban....	3,000	3.	238	16.81	7.1
4 City.....	1,300	3.4	408	24.77	6.1
5 Private.....	1,695	1.	285	15.20	5.3
6 City.....	10,170	21.	2,312	109.10	4.7
7 City.....	7,850	5.5	820	38.62	4.7
8 Private.....	11,970	2.2	848	29.01	3.4
9 City.....	6,780	6.	1,830	58.34	3.2
10 City.....	20,340	11.	2,876	92.49	3.2
11 City.....	8,340	20.	6,700	162.24	2.4

Mr. Mansfield pointed out that in the case of garage No. 8 little winter load exists. Arrangements have been made in the case of garage No. 9 to refrain from starting the charging set until the elevator has shut down for the day, thus reducing the demand and cutting the bill down to a 1.8-cent kw-hour rate on the monthly basis.

The sales department of the Boston Edison Company has authorized one special agent to work in harmony with the electric vehicle agents and to assist the consumers in securing the best possible service from their apparatus. He cited a case where the service given by a 1000-lb. electric truck was increased from 2.4 miles per kw-hour to 3.33 miles by improved methods of charging. The truck was formerly charged with 128 amp-hours daily, and as the service requirements were only 90 amp-hours, the battery was given more current for a longer time than was desirable for the best results. The plan was tried of adding simply 52 amp-hours to the battery on the evening of the day when it had started work with a charge of 128 amp-hours. This gave 90 amp-hours with which to start the next day, and at the second night all the charge was exhausted. On the third morning the machine started out with a charge of 128 amp-hours again, and the following night only 52 amp-hours were put in, this cycle of operations being regularly repeated.

Mr. N. T. Wilcox, of Stone & Webster, said that he had considerable confidence in the future of the electric vehicle. The present development warrants the organization of the association. Central-station men are in a receptive mood, and the difficulties vary widely in different places. Where pavements are uniformly good and grades are moderate, the results are better. Most of the cities in New England are improving their street surfaces. The Stone & Webster companies are making low prices for energy used in vehicle charging, and are encouraging the movement as far as they can. The electric motor faced the same scepticism years ago. It is vitally important to avoid making any claims which cannot be substantiated, as these always react against the industry. The field is too large for any resorting to unwarranted claims. Careful advice to customers will result in a steady and increasing growth of business.

Mr. J. B. Barrett, Malden Electric Company, voiced the need of educating customers to the oportunities of electric vehicle service and spoke of the difficulties in interesting garage owners handling many gasoline cars in the electric machine on account of the small income from repairs and attendance. This is a point in favor of the electric vehicle user, but the garage owner prefers to pay chief attention to a class of cars that will bring him in a large amount of extra revenue, regardless of the cost to the automobile owner. Mr. J. H. Hunnewell, local manager of the Lowell Electric Light Corporation, spoke at

some length upon the vital need of proper care for electric vehicles of both the commercial and pleasure types. It is a question if an all-electric garage is not necessary even in cities of 100,000 inhabitants, where electric vehicles are being introduced. It is still a problem as to the financial success of such garages in medium-sized towns. He has found it very hard to interest local garages in electric automobiles. The customers of most central stations depend upon them for skilled advice in regard to all the apparatus which they buy, and it is not easy to exaggerate the importance of proper advice in regard to the maintenance of electric vehicles and especially the care of storage batteries. The central-station man naturally regards with enthusiasm any device which will help consume energy, but unless proper care is given to such devices bad results often follow, and the expansion of central-station services is hindered. Mr. Hunnewell thought that possibly in some cases the assignment of more electric vehicle salesmen to a given area might help to popularize the service and result in better handling and maintenance of equipment.

President Blood then read a memorandum of the experience of one central station in trying to establish an electric vehicle business in its territory. In this particular instance the lack of aggressive campaigning on the part of the manufacturers, failure to follow up prospects, inability of the batteries tried to meet the conditions, use of out-of-date charging equipment and other neglects had resulted in the general failure of the attempt to push the cause into public favor. Evidently the requisite technical ability was wanting somewhere. Mr. Day Baker, General Vehicle Company, Boston, rejoined with the cogent remark that he had put 89 electric vehicles into New England in the past two years in the face of unlimited scepticism, and every one of these machines is running successfully to-day. He said that the need of educational work is very great. Mr. Frank J. Stone referred briefly to the energetic efforts in this field which are being made in New York and Brooklyn, a $12,000 garage fund having been recently set aside for use in the latter place. The New York Edison Company operates 65 electric machines.

Mr. J. C. Cook, Electric Storage Battery Company, Boston, then gave an interesting blackboard talk on the "Misuse of Batteries," showing by sketches and pithy comments the causes of numerous troubles obtained in service by inexperienced battery owners. The most difficult point is to get owners to stop charging their batteries at the proper time. If the charge is too small, the capacity of the batteries is reduced, while overcharging, on the other hand, leads to a sudden dropping in mileage capacity after a period of good service which can only be overcome by a prolonged slow charging. If overcharging is carried too far the plates may have to be replaced. Many owners of batteries are unwilling to take the trouble to measure the specific gravity and temperature of a pilot cell, which are better indications of the condition than the voltage. The amp-hour meter is still more convenient. Many batteries have been injured by being allowed to stand in a partly charged condition too long, or by the owner's going to Europe and leaving the vehicle in his private garage with no attention for several months. Excellent results can be obtained by employing the two-rate method of battery charging, using the high rate up to approximately the last hour and a half of charging. Only when the specific gravity and voltage cease to rise is the battery fully charged.

Mr. Day Baker briefly discussed unscientific methods of charging, and Mr. F. J. Stone cited some amusing cases of battery abuse which were drawn from the field. He suggested that in small towns the man who looks after the electric vehicle of the central-station company ought to be able to help the private vehicle owner to secure better results.

The meeting closed with a lantern-slide exhibit of recent vehicle applications by Mr. S. G. Thompson, of the Studebaker Company, among which was shown a 7.5-ton truck capable of doing the work of 14 horses, with two sets of batteries and a total operation of 20 hours per day at an estimated cost of $13 per diem.

District Heating.

The National District Heating Association held its second annual convention at Toledo, Ohio, on June 1-3. Mayor Brand Whitlock welcomed the convention in appropriate terms. Mr. D. J. Hard, of Cleveland, in response said that there are now approximately 400 heating stations in the country, and that their growth is bound to be much more rapid as their advantages are demonstrated.

President A. C. Rogers in his address took as a key-note the conservation of natural resources, and showed how this could be served by a concentration of all generating sources consuming fuel. Large units are the most economical; they can be installed under the best conditions, and lead to a great reduction in productive cost and give the most for the least. A regard for these considerations, he said, will greatly enlarge and extend district heating.

HOT-WATER HEATING STATION AT COLUMBUS.

Mr. W. A. Wolls described the hot-water heating equipment of the Columbus Railway & Light Company. The steaming installation consists of six 350-hp B. & W. boilers, three of which are used for the heating system. The company operates a generating equipment consisting of one 250-kw, one 400-kw and one 500-kw, three-phase alternators driven by reciprocating engines, and one 1000-kw alternator driven by a steam turbine. The electrical equipment at the heating station is in parallel with that of the main generating station, thus permitting the heating station to vary its electrical output in accordance with the demand for heat. The turbine is operated condensing except in an emergency, the exhaust steam from the engines alone being used to heat water for the heating system. A vacuum is maintained within the condenser heater relative to the water temperature required, at the same time all condensed steam is returned to the boiler and no steam escapes to the atmosphere. The load carried by the engines is in proportion to the demands upon the heating system.

The heating supply mains are laid underground to an average depth of 4 ft., encased within a rectangular wood conduit constructed of rough cypress boards, the conduit is built up three ply with an intervening air space of approximately 0.5 in. between boards, the space within conduit around the pipe is filled with oil-treated shavings. Along side of each main conduit is installed a galvanized iron pipe line varying in size from 0.75 in. to 2.0 in. for the furnishing of compressed air, the use of which will be mentioned later. Under and parallel to each conduit is laid a 3-in. porous drain tile provided at intervals with sewer connections; the top of conduit is covered with a good grade of tarred felt before the trench is filled. There are 4.1 miles of mains, which are standard commercial steel pipe, in sizes from 12 in. to 2 in. diameter; all pipes are joined together with screw couplings; all valves and fittings are screw except the 12-in. expansion joints. The mains are anchored at intervals of 500 ft., or less where necessary, by means of malleable-iron flanged collars; one is placed each side of a connecting coupling, and the flanges are fitted to the ends of the conduit. Pipe expansion is provided for by the use of iron-body, brass-sleeve, slip-expansion joints, in sizes of 6 in. and larger; in sizes of 5 in. and under the expansion is taken care of by "U" bends.

Customers' service pipes are installed by the company and charged to the consumer at the company's cost of installing. Genuine wrought-iron pipe, 1.25 in. in diameter or larger, is used for service; all service lines are laid underground to an average depth of 30 in. in conduit of the same general construction as the main conduit, without the use of drain tile; service cocks of the inverted plug type are located at the curb line for each service line.

Heating service is furnished to customers at the rate of 15 cents per square foot of radiating surface per year, by contract. The first payment of 5 per cent of the year rate is payable at the company's office on or before the tenth day of October, 15 per cent on the tenth day of November, 20 per cent each on the tenth day of December, January and February, 15 per cent on the tenth day of March and 5 per cent on the tenth day of

April. Heat is furnished without extra charge at all other times during the year when the outside temperature is below 70 deg. Fahr. The contract also specifies that all exposed pipe surface connected to the heating system in the basement of the customer's installation shall be paid for as radiating surface, or properly covered with a good insulating material, which must be satisfactory to the company. No difficulty has been experienced in enforcing the latter requirements.

At present there are approximately 205,000 sq. ft. of radiating surface connected to the system. Some of the original installations are operated on the "choke" system, others are connected to former gravity systems and operated as such at present, the boilers being cut out by means of valves. All new installations are of the two-pipe forced circulation type, using a special disk valve connected to the return end of each radiator. These valves are constructed with an adjustable orifice, adjustment being made with a master key by the company's representative. All adjustments are made relative to the differential pressure and a maximum drop of 30 deg. Fahr. in the temperature of the water in the radiators.

It is required by the company that temperature-controlling thermosats be installed upon each customer's installation. The company furnishes compressed air at a pressure of 15 lb. gage for their operation. The results obtained by the use of thermostats upon this system have been very satisfactory to both the customer and the company. The company has available at all hours competent men to care for all trouble calls, for which service the company makes no charge.

In replying to inquiries after presenting his paper Mr. Wolls said that 45 per cent of the station's cost of operation has been charged to the hot-water heating department and 55 per cent to the electrical output. This division is in favor of the heating rather than the electrical end. The rate for indirect radiation is 50 per cent higher than for direct radiation. That is to say, if a house would require 1000 sq. ft. of direct radiation, the charge would be 1500 sq. ft. for the indirect radiation. He said that very little deterioration had been experienced with steel-pipe mains. Economizers were found to be a paying proposition, even though they do require attention. All customers are charged the same rate, namely, 15 cents per square foot. One customer has 60,000 sq. ft. of radiating suface, but Mr. Wolls stated that he would rather have this distributed among a large number of small customers, owing to the heat waste in the large building thus supplied.

CENTRAL-STATION STEAM HEATING IN DETROIT.

The two distinct steam-heating installations in Detroit were described in a paper by Mr. A. D. Spencer. One of these is owned by the Murphy Heating Company, which operates a vacuum system in connection with an electric-power plant, a cold-storage plant, an ice plant and a central-station brine-circulating system. The other, which is owned by the Central Heating Company, consists of two practically separate plants and systems, a live-steam-power and heating system in the business district and an exhaust-steam heating system in a residence district.

The Murphy Heating Company owns 20,065 ft. of steam mains varying in size from 6 in. to 30 in. It has 320 customers, with 380,000 sq. ft. of radiation. All steam is sold on a meter basis, the rates per 1000 lb. varying from 58 cents to 53 cents.

The live-steam plant of the Central Heating Company furnishes steam to 400,000 sq. ft. of radiation and the exhaust-steam plant serves 300,000 sq. ft. Its rates vary from 58 cents to 45 cents per 1000 lb.

As a result of the operation of the Detroit plants the author concludes that a live-steam heating system can profitably compete with private heating in high-class residence districts, if considerable business can be obtained in a compact territory, but that a live-steam heating system in a business district should not be undertaken except in connection with an electric supply business. He claimed that the advantage of an exhaust-steam heating system depends upon the ability to dispose of electricity generated at a profitable figure. In general, unless the heating load is very small compared to the electrical business, it will be difficult to dispose of the energy at a profitable figure; where there is competition with a larger plant the value will be low; where there is no larger plant it will be difficult to dispose of the energy at any price.

During the discussion of Mr. Spencer's paper he said that the type of meter now used has roller bearings, and is designed particularly with reference to conditions under which they work with respect to heat, expansion, etc. In spite of this they get dirty and stop. The dumping style of meter that was used wore down and became inaccurate. In the case of meters that have been stopped, the rule is to confer with the customer before rendering an estimated bill.

Mr. George W. Wright, of Baltimore, said that the contract of his company provides that if the meter fails to register the charge is to be on the basis of previous bills. All meters are inspected and read every day, and in case of a defective meter a man is sent at once to make any repairs, so that it will be going by the next day. On an average not over 5 per cent of the meters actually stopped recording. All meters are brought in at the end of every season and tested for accuracy and put in good condition. The main loss in meter recording is from overloading in the morning when the heat is turned on in buildings, a remedy for which is to install a meter of large size. In reply to an inquiry as to whether it would not be desirable to put a small amount of heat in office buildings through the night, and thus lower the high consumption in the morning, Mr. Wright said that every customer wants to operate his own system, and that when he leaves at night he shuts the valve, knowing that his bill will not be increased during the night.

Mr. George D. Higgins said that as his company has 400 meters it would be practically impossible to inspect them every day. Mr. H. R. Wetherill, of Peoria, said that his meters are read twice a month, though a few are read once a day and some once a week. The cost of keeping the meters up in a season amounts to over 50 per cent of the total distribution cost. Mr. Wright said that the meter difficulty was one that could not be avoided, as the mill scale and the dirt in the system will come down though everything be kept as clean as possible.

In answer to a query, Mr. Spencer said that an engine using steam at 140 lb. pressure during the heating season is operated with between 8 lb. and 9 lb. of back pressure. Mr. De Wolf quoted an authority to the effect that ordinary aluminum paint is about the worst thing that can be put on a steam radiator, and that about the best thing for this use is white enamel. There was considerable discussion as to whether more radiation could be obtained from a given weight of live steam than the same weight of exhaust steam, but none of the statements made on one side or the other were based upon exact determinations, but appeared to be expressions of opinion.

A considerable part of the discussion of the paper was taken up with the question of buying coal on the heat-unit basis, on which some difference of opinion developed. Mr. Schott said that the desirability of the heat-unit basis is greatest when the fuel comes from fields where the quality of the coal is far from uniform.

HUMIDITY.

Dr. W. W. Brand delivered a lecture on the necessity and benefits of humidity, in which the physical relations between dry air and moist air as affected by the temperature were fully discussed. The speaker claimed that the least amount of heat is required for maintaining an agreeable temperature when the humidity is properly adjusted and stated that a relative humidity of 50 per cent is good for general purposes.

CENTRAL-STATION HEATING.

A paper on the general subject of district steam heating by central stations was presented by Mr. F. H. Stevens, who remarked that since there are now so many district heating plants that are remarkably successful, it ill behooves the manager of any electric lighting or railway company whose station is located within a mile of the business section of a city to ignore the subject and consider district heating prohibitive in his particular case. He cited an example to show that an assumed 5000-kw plant having an output worth $250 per hour without

steam heating could increase its hourly revenue to the extent of $135 by expending $26.25 in the production of steam for district heating purposes.

THERMAL INSULATION.

In a paper by Mr. W. E. Richards it was stated that the apparent failure of district steam heating when started about 40 years ago could be attributed to the lack of proper knowledge of thermal insulation. At the present time steam heating mains are so protected that steam at 50-lb. pressure can be transmitted over one-half mile with a temperature drop not exceeding 2 deg. Fahr. A considerable difference exists in the costs of various insulating arrangements. For example, a concrete construction complete with wood-felt lining for hot-water main with feed and return main of 4-in. pipe will cost approximately $6 per foot, while a triple wood box, with shavings, the main being the same as above, will cost about $2 per foot. The author questioned the advisability of expending the extra amount for securing a concrete conduit that will outlast the pipe, while the wooden box may prove more economical.

UNDERGROUND INSULATION.

The subject of underground thermal insulation was treated in a paper by Mr. C. H. Staten. The author said that a permanent as well as an efficient underground insulating system can be obtained by the use of a tile conduit made up in half-sections with independent supports for the enclosed pipes, which should be covered with an insulating medium composed of asbestos fiber and ground sponge.

COST OF SUPPLYING HEAT.

A paper by Prof. J. D. Hoffman contained an outline of the thermal energy relations in furnace, boiler and steam-heating installations, in order to show the theoretical cost of supplying heat to consumers.

CENTRAL-STATION STEAM HEATING.

Mr. R. D. De Wolf presented a paper entitled "Advantages to Be Derived from the Combination of Heating and Power Business from the Central Station," in which were discussed the features outlined in his recent paper before the National Electric Light Association, as noted on page 1454 of our issue for June 2.

In a discussion of Mr. De Wolf's paper, Mr. Bishop said that he had recently investigated 28 isolated electric lighting, power and heat plants and found that the firing and labor cost was $1.05 per ton of coal, whereas the figure for a central-station plant was less than 40 cents per ton. In a comparison of central-station and isolated plants, Mr. De Wolff said that the latter could not get the experience in the design and operation that the central station enjoys, while its cost for supplies, repairs, maintenance, etc., will be higher. The central station, moreover, offers a greater reliability of service. The isolated plant has an unbalanced electric and steam load, while the central station can balance both of these.

CENTRAL HEATING STATION.

In a paper entitled "A Central Station Operated Entirely as a Central Heating Station, Exclusive of Electric Light or Other Industries," Mr. Byron T. Gifford outlined the operating features of a central heating station. He stated that a certain "straight fuel-burning" hot-water heating system had proved commercially successful. This plant burned 86 lb. of coal per year per square foot of radiation surface.

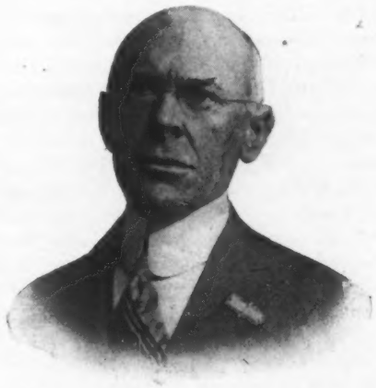
GENERATING AND DISTRIBUTING STEAM FOR HEATING.

In a paper by Mr. Charles R. Bishop were discussed some of the factors affecting the cost of generating and distributing steam for heating. The author endorsed the prevailing method of purchasing fuel upon the basis of the heat units contained in each pound of coal or gallon of oil. Boilers should always be kept free from scale by inserting boiler compounds or using tube cleaners. Use should preferably be made of mechanical rather than manual stokers for the most economical generation of steam.

In the utilization of the steam, it is to be noted that the actual efficiency of an engine delivering exhaust steam is not as important as the output rating of the engine. In an exhaust-steam heating installation, the engines act as reducing valves between the boilers and the heating system and at the same time produce mechanical energy without appreciably lessening the heat energy. After being exhausted from the engines, the steam enters a main delivery pipe, having at one point a fitting through which steam is taken to feed-water heaters and through a balanced back pressure valve to the air, such discharge connection being necessary to relieve the engine from any unnecessary back pressure at such times as the quantity of exhaust exceeds the heating demand. A direct connection from the boilers is made to the exhaust main for the purpose of supplying the system with the necessary amount of live steam at such times as there exists a heating demand in excess of the exhaust steam supplied. In the live-steam connection an automatic pressure reducing valve is placed, and in the exhaust steam main, before leaving the station, there is located an oil and water separator, having an automatic trap discharge.

Where the station contains several engines, an additional exhaust main should be installed, so that any engine can be run condensing or exhausting to the atmosphere, while other engines are exhausting into the heating mains. The station should be provided with meai for weighing coal and ashes and measuring water to boilers; instruments for determining the flue gas temperatures and chimney drafts; thermometers for determining the temperature of water entering and leaving the economizers or entering boilers; instruments for recording the boiler pressure, back pressure and kw-hour output; indicating voltmeter, ammeter and power-factor meter; recording thermometer for outside temperature, an anemometer and an instrument for determining relative humidity.

The author stated that the charge for all service should be based on meter readings. He claimed that even though the company supplying the heating service also operates an electric generating plant, the price of steam to the consumer should always be estimated as though the company supplied no other service.



Pres. George W. Wright.

SHEET-METAL RADIATORS.

Mr. Herbert Orr presented a paper in which attention was called to the pressed-steel type of radiator which he claimed is not as disadvantageous as some of its opponents have stated. He intimated that it is capable of resisting corrosion equally as well as does the cast-iron type, and is just as effective in transmitting the heat to the space to be heated.

COAL PRODUCTION AND CONSUMPTION.

In a paper by Prof. R. H. Fernald it was stated that if the rate of increase of fuel consumption that has held for the past 50 years is maintained, the supply of easily-available coal will be exhausted before the middle of the next century. The author expressed the opinion that the time is not distant when financial interests in the production of energy will be directed toward the centralization of the producer-gas power plant at the mines, and the distribution of the energy developed either by high-voltage electric circuits or pipe systems for conveying gas.

OFFICERS.

The following officers were elected: President, Mr. George W. Wright, Baltimore; vice-presidents, Messrs. A. D. Spencer, W. J. Grambs and Warren Partridge; secretary-treasurer, Mr. D. L. Gaskill, Greenville, Ohio; executive committee, Messrs. A. C. Rogers and E. J. Keifer. It was decided to hold the next meeting in the East next year, at a place which will be selected later.

Massachusetts Commission News.

The Massachusetts Gas and Electric Light Commission gave a hearing on June 10 upon the petition of the Cambridge Electric Light Company for authority to issue 500 shares of new capital stock at a price of $200 per share, the par value of the issue being $100. The company was represented by its counsel, J. J. Myers, Esq., its president, Mr. J. Q. Bennett, and its treasurer, Mr. Welles E. Holmes. President Bennett explained that the proceeds of the issue are required to meet the cost of enlargements and changes in the power plant and distributing system occasioned by a rapid growth of the power business within the past few months. The company's day motor load exceeds its lighting load in magnitude. A large packing house, pump manufactory and hose plant have lately been secured as customers, and the existing capacity of the generating plant is inadequate to handle the service. The present rating of the generating station is 4500 kw, and after an investigation extending over a period of about two years the company has decided to install low-pressure steam turbines of 500 kw and 1500 kw rating, in connection with its present steam-engine equipment. The company hopes by this means to cut down its steam consumption per kw-hour from about 22 lb. to 15 lb., and to generate electricity at a lower cost than at any other plant in the State, with the exception of hydroelectric stations.

The low-pressure turbines are to be installed on the present floor of the Western Avenue station, with condensing equipment in the basement. The switchboard is to be transferred to the end of the building in the form of a double-deck structure. The coal-handling plant will probably be remodeled in the near future, and the boilers may be equipped with automatic stokers. Fifteen 100-kw power transformers of 2300 volts to 550 volts ratio will be installed in connection with the large energy customers secured and the underground service of the company will be extended to their premises. The estimated cost of these improvements is:

STATEMENT OF PLANT REQUIRED BY CAMBRIDGE ELECTRIC LIGHT COMPANY, 1910.

Two low pressure turbo-alternators, 500 and 1500 kw	$40,000
Moving switchboard at station	10,000
Underground conduit extensions	26,022
" cables	27,983
Large transformers, 15-100 kw units	6,032
" installation cost	1,500
Coal handling apparatus at station	20,000
Total	$131,537

The estimated cost of automatic stokers for eight 400-hp boilers is $20,000.

Mr. Bennett stated that the company's rates will permit the new service to be carried at about 1.8 cents per kw-hour on a nine-hour day. The lighting rate is 12 cents per kw-hour, maximum. Losses in lighting service distribution aggregate 33 per cent, compared with 7 per cent on alternating-current motor circuits. The station economy will be increased by the addition of about 1500 kw of new motor load, and the smoke nuisance from these large manufacturing plants in Cambridge abated. The company has found it more desirable to sell energy on the basis of 2 cents per kw-hour for a use of nine hours per day than to sell it for 1½ hours daily at a rate of 12 cents per kw-hour. It is somewhat uncertain, however, as to the effect of a motor load which is increasing beyond the existing capacity used in lighting service on the peak, since the lighting load cannot fill the gaps in the night motor load curve. The hearing was closed.

Massachusetts Legislative News.

Governor Draper has signed the resolve providing for definite steps toward the electrification of steam railroads in the Boston district through the requirement that during the coming four months the companies shall investigate the problem of electrification within the metropolitan area and report their conclusions to the Joint Commission on Metropolitan Improvements by the middle of the fall. This commission includes the Railroad Commission of the State, and the resolve provides for a definite report on the question of electrification to the Legislature of 1911. It is probable that at that time the draft of an act will be presented by the joint board requiring the work to be done within a specified time. During the present session the popular demand for the substitution of electricity for steam has reached unprecendented proportions, and although the railroads pleaded for long delay on the ground of initial expense the pressure of public opinion was so strong that a positive policy in favor of electrification was inevitable on the part of the General Court. In recognition of the request of the New York, New Haven & Hartford management for time to standardize methods and insure that the Boston work should be done as economically as is consistent with a first-class installation the Legislature refrained from passing a bill making electrification obligatory at this time. The trend of affairs indicates that from this time on perfunctory explanations of physical and financial difficulties will have to give way to definite progress toward a realization of electrified service. The appearance of Former-Chairman Jackson, of the Massachusetts Railroad Commission, before the committee charged with the electrification bills on behalf of the work, was a potent force in securing the favorable report. In place of general recommendations it is anticipated that the joint commission will determine a clear-cut plan of action, and it is probable that the work will be legally set in motion inside of a year.

Another matter of wide interest in electrical circles was settled last week by Governor Draper's signature to the bill authorizing the New York, New Haven & Hartford Railroad Company to acquire control of the Berkshire Street Railway Company, for the purpose of developing the hill towns of Western Massachusetts and co-ordinating the service of the street-railway lines in that section with the steam-railroad service. The general scope of this bill has been fully discussed in these columns. By the passage of the law the portion of the State west of the Connecticut River is given a new lease of industrial life. Gaps in through lines will be built over within a few months, passenger service will be established between the larger centers of population and remote rural districts which have been moribund for years in spite of good scattered water-power facilities; and costly means of transit through the southern Berkshire Hills region will be superseded by the frequent and fast service of new trolley lines. An expenditure of about $2,000,000 on improvements will be made as soon as possible. An interesting feature of the situation is the passage of the law a year after an adverse report on the question by the Railroad Commission, which held that private capital could be found to develop the district electrically if industrially necessary. The board will continue to exercise close supervision over the Berkshire system, in common with other street-railway lines in the State.

Maryland Public Service Commission News.

Former City Solicitor William Cabell Bruce has qualified as the chief counsel to the Maryland Public Service Commission and has been in daily conference with the members of the commission for several hours since his appointment. Mr. Bruce will within the next few days announce his appointment of the assistant counsel to the commission. The position pays $3,000 a year and the friends of Mr. William Pinkney White, Jr., are urging him for the appointment. Mr. White is indorsed by Governor Crothers and Attorney-General Straus, and his appointment, it is said, would be gratifying to the members of the commission.

Pressure has been brought to have the commission investigate the circumstances attending the recent defeat of several measures which were presented before the City Council of Baltimore. Among the most recent of these measures was the Bloede ordinance to establish a competitive electric light and power company in Baltimore. Commenting on the proposition Attorney-General Straus said: "So broad are the powers which are conferred on the Public Service Commission that I am not at this time prepared to say that it could not take such action; at the same time, however, I hardly would say that it could. The question is one that requires some study and investigation. On the whole, however, it appears to me that any investigation conducted with a view to disclosing possible irregularities would come under the purview of the Grand Jury rather than of the Public Service Commission."

City Collector Frank Brown has raised the question whether or not Baltimore should really be compelled to defray a portion of the expenses of the commission. Mr. Brown has issued the following statement: "It is my opinion that any taxpayer in the city of Baltimore can go into court and restrain the city from paying any portion of the salaries and expenses of this commission. The city has no say in the appointment of the commission, and nothing whatever to do with its work. We should not, therefore, be called upon to pay any part of the money required for its maintenance. I am surprised that members of the Legislature should have voted for such a bill. They did it, of course, because they wanted to pay the commissioners big salaries, and because under the constitution of the State no official, barring those specified in the constitution, can be paid more than $3,000 a year. They had to put the extra expense of the commission on somebody, so they again made Baltimore City the dumping ground of the State. It is a wonder to me sometimes that the city was not made to pay half of the Governor's salary. These things are not fair to the taxpayers of Baltimore. The chairman of the Public Utilities Commission receives a salary of $6,000 a year, and each of the other two commissioners receives $5,000 a year, while the general counsel is paid $4,800 a year. Now, the taxpayers of Baltimore must make up the difference in these salaries between $3,000 and the amounts actually to be paid. Inasmuch as the city gets no benefit from the commission, and has no say in its appointments or its work, I do not see how any court would rule that we should have to pay any part of the salaries or its running expenses." Mr. Brown is an ex-Governor of Maryland and he has been put forth as a candidate for another term.

Wisconsin Rate Commission News.

The hearing in the case of F. L. Gross against the Wisconsin Telephone Company, which was held before Commissioner J. H. Roemer in Milwaukee, was concluded June 8. Mr. Gross, as a representative of the traveling men, was seeking an order which would eliminate the extra charge of 5 cents for a telephone call from a hotel room. With the exception of the statistics as to the cost of maintaining a house telephone system, practically nothing of importance developed at the hearing.

After having filed with the city clerk of Janesville and the Railroad Commission a declaration of intention to surrender its franchise, the Janesville Electric Company has been granted an indeterminate permit by the commission. The franchise held by the Janesville Company was originally granted to the Thomson-Houston Company in 1885.

The hearing in the matter of the investigation of the stock and bond issue of the Platteville Gas Company, which was to have been held on June 2, has been postponed owing to the failure of the defendant to produce the proper records.

The Railroad Commission has authorized the Neillsville Electric Company to issue stock and bonds as follows:

1. Four hundred and eighty shares of common stock of the par value of $50 each; said stock to be issued for money only and at not less than par.

2. Bonds, of the par value of $60,000, of the denomination of $100 each. One-third of this amount, or $20,000, is payable on July 1, 1921, one-third on July 1, 1926, and one-third on July 1, 1931. These bonds are to bear interest at the rate of 6 per cent per annum, and are to be issued for money and for not less than 75 per cent of the par value. The stock and bonds are to be sold for the purpose of supplying the company with funds for the payment of outstanding indebtedness; the construction of a dam near the city of Neillsville; the construction of a transmission line; the purchase of the necessary real estate and flowage rights; and the construction and equipment of a power house. The company must file verified statements with the commission showing in detail the items to which the proceeds of the sale have been applied, as well as the moneys derived from the sale of said stock and bonds, within 30 days after the unreported amounts exceed the sum of $5,000.

New York Public Service Commission News.

The Interborough Rapid Transit Company last week presented to the Public Service Commission its long promised proposal for the improvement and extension of its rapid transit lines. The proposal refers almost entirely to the extension of the elevated lines. It is to the effect that the company shall be allowed to third track its Second and Third Avenues roads with an extension across Queensboro Bridge; a connection with the West Farms branch of the subway; to complete the third track on the Ninth Avenue line and build an extension across the Harlem River, at Central Bridge, and construct an elevated three-track line north on Jerome Avenue to 194th Street. The Third Avenue elevated line is to be extended from its present terminus at Bronx Park through Webster Avenue, Gun Hill Road and White Plains Avenue to Becker Avenue. This line is to be built as a two-track road with the privilege of later adding a third track. It is also proposed, if a satisfactory franchise can be obtained, to complete the Steinway Tunnel and put it into operation as a part of the existing subway with open connection between the tunnel and the subway at Grand Central Station, and with free transfers, giving a through ride between Long Island City and all parts of New York reached by the present subway for 5-cent fare. The commission will take up consideration of these proposals at its next meeting. Laws have recently been passed by the Legislature making possible this third tracking improvement and also the opening and operation of the Steinway Tunnel.

The commission is continuing to hold almost daily hearings upon the Third Avenue reorganization plan, but so far there is no evidence as to when these hearings will end and a decision in the matter be made. At one of the hearings last week, Mr. Charles L. Littlefield, former Congressman from Maine, appeared as attorney for what is known as the Knickerbocker Stockholders' Committee. Mr. Littlefield announced that he was present in order that he might cross-examine Mr. Milton G. Starrett, chief engineer of the Metropolitan Street Railway Company, who had testified at a previous hearing as to the cost of electrification of the Third Avenue road. The attorney for the bondholders committee protested against the appearance of Mr. Littlefield, but the commissioners permitted him to take part in the proceedings.

At a conference last week between the Public Service Commission and some of the directors of the Continuous Transit Securities Company, the concern which has applied for the privilege of building moving platforms in New York, the commissioners expressed the opinion that this form of transit would tend to solve the traffic problem of the city, but they suggested that the matter remain in abeyance for a few weeks until the engineers finish their plans for the proposed tri-borough subway. This is the first expression of opinion from the commissioners in favor of the new system.

A conference was held last week between Mayor Gaynor, the rapid transit committee of the Board of Estimate and Apportionment and the members of the Public Service Commission relative to the forms of contract for the tri-borough subway, for which it is expected that advertisements will be published within a few weeks. After the conference, it was announced

that as a result of the public hearings on these forms of contract, held in May, certain changes have been made, but that these have not been important enough to materially affect the contracts.

The application of the Third Avenue Bridge Company for a franchise to operate a line across the Queensboro Bridge was last week referred to the chief engineer of the Board of Estimate. It is understood that a franchise will be granted upon the agreement that liberal transfers will be given by the Third Avenue Railroad Company and its subsidiaries.

The Ithaca-Auburn Power Company has been allowed to withdraw, without prejudice to the making of new applications, its recent applications for the issue of capital stock. The company, which is a newly organized one, proposed to issue its common capital stock to the amount of $350,000, of which $250,000 was to be issued to the Remington Salt Company and $100,000 to the Ithaca Street Railway Company. The withdrawal of the applications is due to the fact that the commission considered the plan to be wholly in contravention of section 70 of the Public Service Commissions law which will not permit the issue of more than 10 per cent of the capital stock of the Ithaca-Auburn Company to the Remington Salt Company and more than 10 per cent of the same stock to the Ithaca Railway Company.

The Public Service Commission, Second District, has authorized the Fulton County Gas & Electric Company to issue three-year 6-per cent gold notes, dated March 1, 1910, for the aggregate principal sum of $99,000. The notes are to be sold at par and accrued interest, and the proceeds are to be used for the construction of a transmission line from the power station of the Mohawk Hydroelectric Company, in Ephrata, to the station of the Fulton County Gas & Electric Company, in Gloversville.

The Geneva-Seneca Electric Company has been authorized to execute a mortgage to secure bonds to the amount of $750,000 instead of $500,000, as it is believed that the company will be required to expend a larger amount of money than was heretofore contemplated by reason of the purchase of the property, rights and franchises of the Economic Power & Construction Company.

The Conant-Bryant Power Company has been authorized to begin construction and exercise franchise in the town of Wilson, Niagara County, and also given authority to issue its stock to the amount of $25,000, the proceeds to be used for the purchase and installment of an electrical plant and power house with necessary equipment and necessary lines in the village.

Variable-Frequency Generator.

Mr. G. Faccioli was recently granted a patent on a modification of a self-exciting generator patented by Mr. William Stanley. The machine consists of stator and rotor windings, the latter provided with a commutator, and the two windings connected to each other and to the load circuit. The exciting current circuit is through the stator and rotor windings in series, and the load current is derived from both the stator and the rotor windings. The frequency of such a machine is equal to the frequency of rotation (that is, the number of pairs of poles times the revolutions per second) multiplied by the number of rotor turns and divided by the sum of the stator and rotor turns. Thus, if stator and rotor have the same number of turns, the frequency of the current delivered is one-half the frequency of rotation.

Mr. Faccioli adapts this machine to variable frequency operation over a very wide range by connecting the stator and rotor windings to each other through a variable voltage transformer, instead of directly. With the connections thus made, the frequency of the currents delivered is equal to the frequency of rotation multiplied by the transformer turns, and divided by the sum of the secondary and primary turns of the transformer. The turns connected to the rotor terminals are called, for convenience, the "primary" turns, and those connected to the stator terminals are called the "secondary" turns. By varying the ratio of transformation of the transformer, the ratio of the secondary turns to the sum of the secondary and primary turns is varied, and consequently the frequency of the currents generated in the machine may be varied over wide ranges.

CURRENT NEWS AND NOTES.

Meter Tests.—Tests of gas and electric meters made on complaint during the month of May by the New York City Public Service Commission gave the following results: Gas meters, 41.9 per cent fast and 11.1 per cent slow. Electric meters, 11.1 per cent fast and 4.4 per cent slow.

Underground Construction Proposed in Pasadena.—It is said that the city of Pasadena, Cal., will make an effort to cause all telephone, telegraph and electric service wires on Fair Oaks Avenue, between Raymond Hill and Colorado Street, to be placed underground at a not far-distant date. It is suggested that the poles supporting the trolley wire be used also for the street-lighting lamps.

Wireless Amateurs Organizing.—The amateurs in wireless telegraphy, under the lead of the New York and Philadelphia societies, are organizing a national movement to resist the proposed Federal legislation restricting wireless. They are anxious that Congress may give them a full hearing before acting in the matter. A meeting of the Philadelphia amateurs has been called for June 20, at which time the attorney for the national movement, George Hiram Mann, of Washington, will make a full report on the present status of the proposed laws.

Freaks of Lightning.—According to newspaper reports from Germany lightning struck an infantry regiment that was marching near Dresden on June 7, and a whole company was hurled to the ground. Three soldiers were killed and 15 others seriously injured, it is said. The day before, the newspapers relate, during a baseball game at Pony, Mont., lightning struck the grandstand. Mrs. M. E. Buck, wife of the superintendent of the Madison River Power Company, was holding a sunshade over her head. The lightning struck the sunshade, and branching off on the ribs of the umbrella, knocked down five women and four men. Mrs. Buck received a severe shock, but was not seriously injured apparently. Six out of a party of excursionists were killed by lightning in Berlin, June 12, and many others injured. Many telephone and telegraph wires were leveled by the storm. A dispatch from Breslau states that seven deaths occured there from lightning June 12, making a total of 18 deaths by lightning in the province of Silesia in three days.

Ohio Telephone Rates.—Since the announcement of a restoration and equalization of rates in Ohio by the Bell companies, it has been stated that the United States Telephone Company will not issue a new schedule of rates, but instead some adjustments will be made to render them uniform throughout the State. The Independent rates are already higher than the Bell rates, and, as there is no further occasion for engaging in rate wars, the committee appointed by the Ohio Independent Telephone Association to co-operate with President Davis, of the United States Company, in formulating a schedule of rates has advised that no radical changes be made at present. The suit brought in the Federal Court about a year ago by the United States Telephone Company, seeking to have the Bell companies restrained from interfering with its contracts with the Independent local companies, was recently dismissed by Judge R. W. Tayler, who had decided one or two of the main contentions adversely to the United States Telephone Company. This virtually puts an end to the litigation between the Independent and Bell companies, with the exception of the suits brought to prevent the transfer of Independent stocks to J. P. Morgan & Company.

Public Service Law for Connecticut.—The Business Men's Association of Bridgeport has held a mass meeting to urge the passage of a public service commission bill in Connecticut on the lines of the New York law. The measure drafted by the Bridgeport organization has received the indorsement of the State Business Men's Association, which is conducting a state-wide campaign for its enactment at the coming session of the Connecticut Legislature, which defeated a similar measure last season.

Safety League for Children.—The Portland Railway, Light & Power Company has arranged a series of lectures on safety, to be delivered by its claim agents, Messrs. F. S. Hughes, L. O. Roberts and A. Molesworth, before the school children of the city. To maintain interest in the attempt to eliminate street railway accidents the children have been encouraged to form the Portland League of Safety, and prizes are being offered for the best composition based on the lectures by the street railway men.

Substitute for Rubber.—Special United States Government Agent Henry Studneczka has reported the production of artificial rubber by a German inventor. The invention is based on the boiling together, under certain conditions, of isoprem with acetic acid, in a closed tube, the result being the creation of a gray composite possessing all the properties of pure rubber and capable of being vulcanized in the same manner as gutta percha. No statement has been made as to the electrical properties of the rubber substitute.

A Strong Attraction.—The conspicuous advertising value of the electric sign was curiously illustrated a short time ago in Chicago, where an electric sign bearing the word "Bar" was, during the rush season, left for a short time in front of a store which had been vacated by a saloon and later occupied as a hardware store. The sign was so effective that the hardware man said that he and his wife were driven almost to distraction by ejecting men who came in and insisted upon being served with drinks. The new tenant finally complained to the police and the too-successful sign was removed.

Electrical Plant-Growth Recorder.—Mr. W. T. Bovie, an instructor at the University of Missouri at Columbia City, has arranged an electrical recording device for measuring the growth of plants. To measure the stem elongation, a thread is attached by means of a clip to the tip of the stalk, this thread being passed around a freely pivoted shaft, the movement of which is magnified by a lever arm which moves over electrical contacts. By the use of this machine it has been demonstrated that the growth of plants occurs with alternate rests. Thus, a test of a bean plant showed that it grew at its most rapid rate about four times each day, with intervening rests of from four to eight hours.

Locating a Broken Wire.—The following morsel is culled from an electrical periodical: "When a telegraph wire is broken or damaged, say, several hundred miles away, how does the operator, sitting in his office, know exactly where the accident occurred? The explanation is simple. It requires, as every one knows, considerable force to send electricity through a wire. The longer the wire the greater, of course, must be the force required. This force is measured in units, called by electricians 'ohms.' Let us suppose that a wire between a New York office and a point 200 miles away has broken somewhere. The telegrapher knows that when the wire was intact there were required, say 2800 ohms to facilitate the current, or 14 ohms per mile. He now finds that he can send current with only 700 ohms. Dividing 700 by 14, he finds that the break in the wire is 50 miles from his end."

Steering Vessels by Electricity.—A Scotch mariner, Bailie J. C. Bogle, of Falkirk, has developed an automatic electric mechanism for keeping a vessel on a predetermined course without aid from the helmsman. One end of an insulated lever, called the contactor, is connected to the compass card, the other end being arranged to make contact with either of two terminals connected with a reversing electric motor that moves the steering apparatus. As the ship swerves from its direction, the contactor makes a contact that completes an electric circuit giving port or starboard helm as may be required. The ordinary steering mechanism is retained unchanged, and the controlling attachment can be promptly disconnected when necessary, as when the vessel's course must be changed to avoid an obstruction or another vessel.

Ornamental Street Lighting in Los Angeles.—Los Angeles is one of the cities that have gone in quite extensively for special ornamental street lighting. The question has come up in that city, however, whether the city itself ought not to bear a portion of the expense, and a delegation of Pico Street residents recently appeared before the City Council and urged the municipal authorities to defray one-third of the expense of the ornamental street lighting on that thoroughfare. Some, indeed, thought that the proportion paid by the city should be one-half. The city electrician estimated that it will cost $113,000 a year to light the streets now having special installations, including First, Third, Fourth, Sixth, Seventh and Pico Streets, and Wilshire Boulevard, after the installations on all these streets are completed. In Chicago and some other cities the cost of these special street-lighting systems is borne by the abutting property owners by an arrangement with the central-station company, the city merely providing the ordinary police lighting.

Lifting Magnets for Handling Raw Ores.—One of the first electric lifting magnets to be designed and used for handling raw magnetic iron ore has just been installed at the open-bed workings of the Moose Mountain Corporation, Ltd., of Canada. Formerly, after the lumps of high-percentage magnetite were loosened, they had to be loaded by steam shovels into cars for transportation to the mills and separators. Some of these lumps weigh over 500 lb., and their sharp, hard edges worked the rapid destruction of the shovel buckets. At the same time considerable non-ferrous material was also picked up and carried along to the separators, where it had to be removed. The new electromagnet was designed especially for picking up the loose magnetic material of the ore, and it can lift 800 lb. at a time. The large lumps are picked up easily, and in the very process itself the magnet works a rough magnetic separation which avoids carrying an amount of refuse material to the mill. Handling the ore by means of the magnet is also found more convenient and rapid than with the shovels. The magnet is 52 in. in diameter and is mounted on an engine-driven crane.

Electrical Banquet at Long Beach, Cal.—On May 26 the citizens of Long Beach, Cal., gave a banquet to officials of the Southern California Edison Company in recognition of the choice by that company of Long Beach as the site of a great steam generating plant, which will have an initial capacity of 40,000 hp, an ultimate capacity of 200,000 hp, and the construction of which will involve an outlay within two years of $2,000,000 and an ultimate outlay of close to $10,000,000. The banquet was held in the Hotel Virginia, the dining-room of which was decorated with 25,000 small colored electric lamps. There were also four electrical fountains in the room and by its entrance was a revolving electric wheel which at intervals stopped, when all lamps were turned off except those which spelled in large letters the word "Edison." The Pacific Electric Company furnished a special car free to carry Los Angeles guests to the Hotel Virginia and return. Among the Southern California Edison officials present were: Messrs. W. A. Brackenridge, vice-president; R. H. Ballard, secretary; S. M. Kennedy, general agent; B. F. Pearson, general superintendent; J. A. Lighthipe, electrical engineer, and H. W. Dennis, construction engineer. Vice-President Brackenridge responded to a toast to the Edison company.

Thief Steals Police Telegraph Box.—A new kind of thief has been discovered in South Chicago. This one stole the signal apparatus, box and pedestal of the police-call box which is customarily located at Eighty-sixth Street and Superior Avenue. After searching all night for the thief the police found the missing signal box at some distance from the scene of the theft.

The Electric Vehicle in Germany.—Many German Municipalities have substituted the electric vehicle for horses for hospital and fire-department service, among them being Berlin, Hamburg, Hanover and Leipzig. The Berlin fire department has figured out that an electric service costs only one-tenth of a horse-and-wagon service; and for hospitals the change has proved equally economical. A great saving of time, which is all-important in ambulance calls, is another obvious advantage. Preference is given to electric cars in cases where the distance does not exceed 50 miles, and the batteries are always kept charged fully, to prevent stalling on the road.

The Telephone and Telegraph Interstate Act.—A substitute provision for the Senate and House amendments placing telegraph and telephone companies under the authority of the Interstate Commerce Commission authorizes telegraph and telephone companies to make different classifications of business and to prescribe different rates for the various classifications, such as day and night messages and press dispatches. As the provisions were originally drawn it would have been unlawful for a telephone or a telegraph company to charge a lower rate for a night than for a day message or a lower rate for press dispatches than is collected on other forms of business.

Convention of Mississippi Electric Association.—During the present week, on June 15 and 16, the Mississippi Electric Association is holding its second annual convention at Greenville. The papers include "Grounding of Secondaries," by Mr. R. P. Strong; "Modern Steam Engines," by Mr. M. E. Griffin; "Depreciation," by Messrs. S. W. Greenland and Jack Abbott; "Tungsten Lamps," by Mr. A. H. Jones; "The Advantages of Electricity for Advertising Purposes," by Mr. C. E. Varney; "Uniform Rates," by Mr. F. J. Duffy; "Meters," by Mr. F. H. Mohns; "Steam Turbines," by Mr. Eskil Berg; "Public Policy," by Mr. F. H. Lotterhos. The president of the association is Mr. A. B. Patterson.

Practical Mechanics' Laboratories at Purdue.—The extensive new practical mechanics laboratories of Purdue University, Lafayette, Ind., will be ready for occupancy when school opens in September. The building contains drawing-rooms for 300 students, a large lecture hall, offices, museum, and roomy machine and woodworking shops in the form of wings extending from the main building. The new practical mechanics laboratory thus has accommodations for 700 students at one time, for instruction in mechanical drawing and shop work. Group and individual drive has been employed in the shop motor installations. Prof. M. J. Golden has charge of the department.

Wireless Telegraphy at Panama.—A new equipment of Fessenden wireless telegraph apparatus has been installed in the United States Navy wireless telegraph station at Colon, on the Isthmus of Panama. The transmitting apparatus is of the high-frequency, 500-cycle type, with rotating spark-gap attached to a 25-kw generator. Two compressed-air condensers using 0.036 cu. ft. of air per minute under 250-lb. pressure are also employed. The transmission ranges on this apparatus include Washington, D. C.; Norfolk, Va.; New Orleans, Key West and Guantanamo. Energy for operating the transmitter is received from the Isthmian Canal Commission plant at Gatun. The receiving apparatus includes an electrolytic detector with special tuning devices for eliminating the interferences from other nearby stations. The new installation was put in operation on March 1, and since that time has demonstrated its superiority over the old outfit.

An All-Alternating-Current Operated Rolling Mill.—The 18-in. and 14-in. merchant mills now in operation at the plant of the Indiana Steel Company, at Gary, Ind., are unique in the fact that alternating-current motors are employed throughout for operating the cranes, hoists and tables, as well as the main rolls themselves. For driving the roughing rolls each mill is equipped with a 3200-hp, 6600-volt, three-phase induction motor, while a 650-hp motor of similar type operates the finishing rolls. The lifting tables, transfer tables, cut-offs, switches and straightening rolls are driven by about 75 small motors ranging from 7 hp to 100 hp. All of the crane, table and miscellaneous motors about the mill are operated by 220-volt, 25-cycle motors. The merchant rolls at Gary are the first large steel mills to be equipped with alternating-current motors throughout, although plans for similar installations elsewhere have followed the successful use of induction motors in this case. In the other mills at Gary direct-current motors are used on all cranes, hoists and tables.

Purdue's 200,000-Volt Transformer.—Students in the electrical engineering school of Purdue University, Lafayette, Ind., have recently completed, under the direction of Profs. C. F Harding and J. W. Esterline, of the electrical department, the construction of a high-voltage testing transformer, rated at 20 kw and capable of developing 200,000 volts. The material used in building this apparatus was part of that employed in the famous "million-volt" transformer exhibited at the Louisiana Purchase Exposition at St. Louis in 1904, and afterward acquired by Purdue University. The reconstructed transformer is air-insulated, and measures over-all 76 in. x 55 in. The rectangular core is 10 in. x 5¼ in. in section and has a mean length of magnetic circuit of 222 in. The 100-volt primary winding comprises 38 turns of No. 4-0 stranded copper cable. The secondary winding is made up of 76,000 turns of No. 30 silk-covered wire, having a total resistance of 68,000 ohms. The magnetizing current is 22.6 amp, having a power component of 16.1 amp. The transformer is to be used for research study in high-tension phenomena.

University of Illinois Locomotive Test Plant.—The locomotive testing plant of the Chicago & Northwestern Railroad has been presented to the University of Illinois upon the recommendation of Mr. Robert Quayle, superintendent of motive power and machinery of the railroad company. This plant was designed under the general direction of Mr. Quayle, aided by Mr. E. M. Herr, now vice-president and general manager of the Westinghouse Electric & Manufacturing Company, who was at that time assistant superintendent of motive power and machinery for the Northwestern road. Prior to the construction of this plant, Mr. Quayle had been made chairman of the committee on exhaust pipes and steam passages of the Master Mechanics' Association, and some time before, while master mechanic at South Kaukauna, had improvised a testing plant by lengthening out the members of a passenger-car truck to make the wheel spacing agree with that of the drivers of the locomotive he desired to test, mounting this truck bottom side up in a pit in such manner that he could run a locomotive upon it. Encouraged by these experiments, he later advocated the construction of the present test plant which was installed at the Fortieth Street shops of the railroad company in Chicago. This plant was the first of its kind to be supplied with permanent mounting rails, by the use of which a locomotive could be rolled on or off the wheels without resort to temporary blocking. Dean Goss, of the College of Engineering of the University of Illinois, announces that the test plant will constitute a portion of the equipment of the School of Railway Engineering and Administration, and that when installed it will be operated under the immediate direction of Prof. Edward C. Schmidt, in charge of railway engineering.

STEAM-DRIVEN TRANSMISSION SYSTEM.

Supply of Cheap Electrical Energy to Scattered Mine Properties in Wisconsin Zinc District.

MANY propositions have been advanced for locating steam-driven electrical generating stations directly at the mines or at other sites where cheap coal is to be obtained, the plan being to transmit thence, over wires, to the point of consumption, the electrical energy extracted from the coal, and so avoid the expensive transportation of the bulky fuel itself. One of the first transmission plants to work out this principle of economy is that of the Interstate Light & Power Company, which has just been completed in the zinc and lead-mining field of southwestern Wisconsin, and represents an investment of $750,000. It comprises a generating station located at the junction of four railroads and on a navigable river, three miles from the Mississippi River, so that competitive freight rates will always make for reduced coal prices. The energy is transmitted to a number of isolated zinc mines scattered over 200 sq. miles of hilly and inaccessible country where the freight charges on the single-spur railroad, added to the long wagon haulages over bad roads, results in more than doubling the price of the fuel.

In addition to the reduced cost of operation for the mining and milling operations carried on in the field, the new electric service insures against costly interruptions due to plant breakdown and failure to receive coal. The water in the section is notoriously bad for boiler-feed purposes, resulting in diminished life of the isolated mine plants, which, as may be supposed, receive at best inadequate engineering attention. In the winter time, delays running into months also frequently result from the impassability of the roads over which fuel has to be hauled. Some of the mines are six miles from the branch railroad track.

Electric drive, on the other hand, requires a capital investment less than one-third that of isolated-plant operation, besides relieving the mine operator of the responsibility of running a power plant. The varying requirements of the mine installation are also met admirably by the flexible characteristics of motor drive. When additional production becomes advisable, the mine owner has only to install more motors and with the capacity of a large generating station behind him, can quickly and easily augment his production rate to any desired amount.

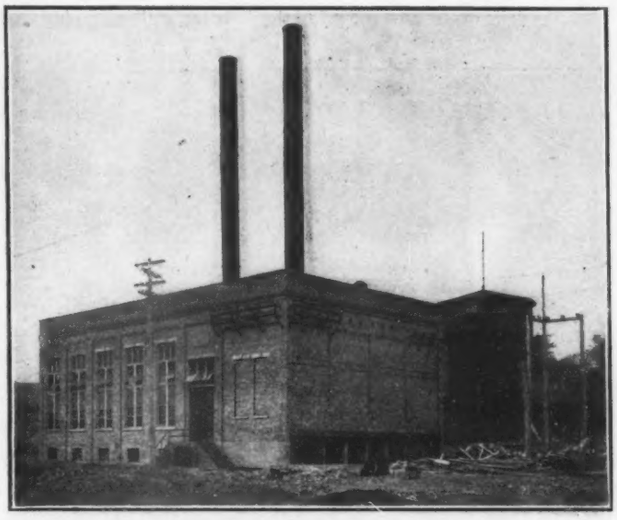


Fig. 2—Exterior of Generating Station.

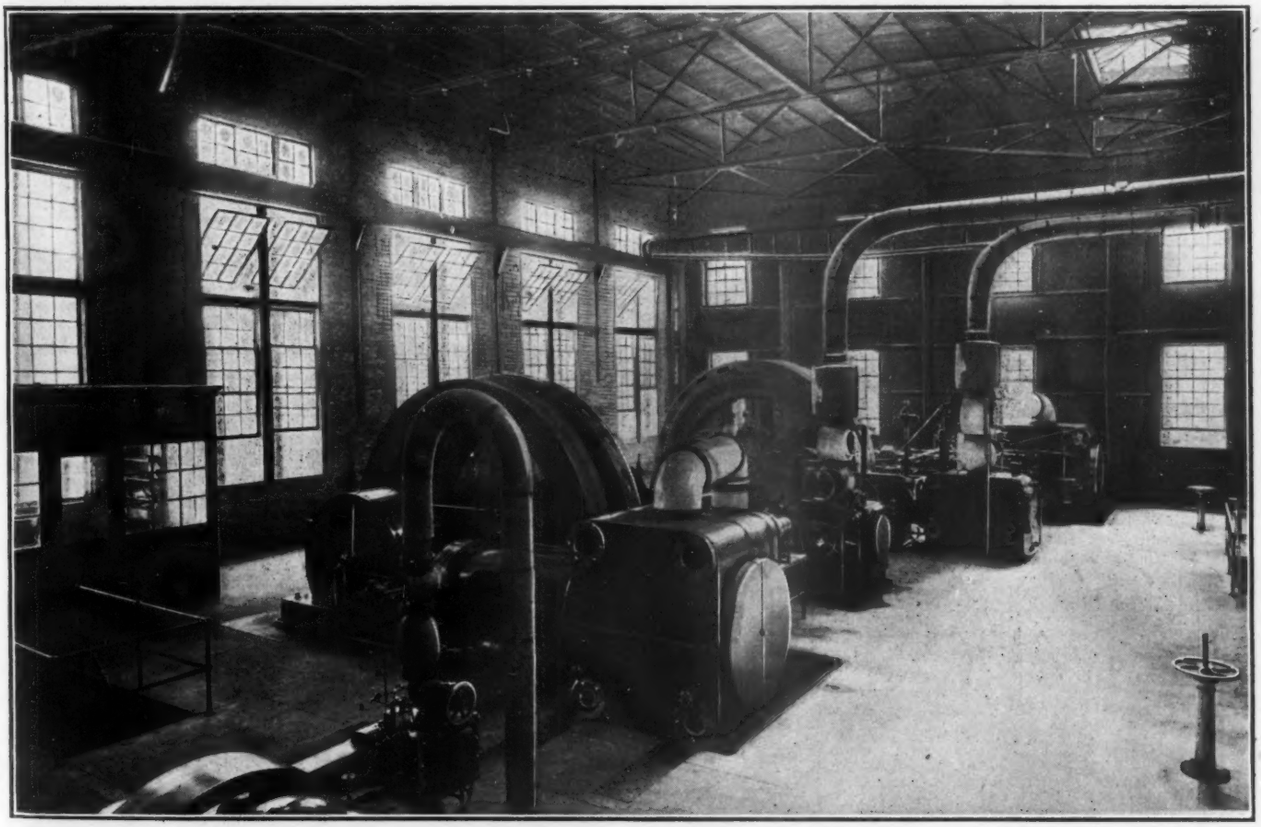


Fig. 1—Interior View of Generating Station.

The foregoing are some of the arguments, since successfully materialized, which led to the construction of a 3000-kw steam-driven generating station at Galena, in the northwest corner

of the State of Illinois, delivering 33,000-volt, 60-cycle energy over 27 miles of transmission line to three substations, across the State line in Wisconsin, from which 2300-4000-volt secondaries supply a number of mines, local transformers reducing the tension to 220 volts for the hoisting mill, pumping and

Fig. 3—Boiler Room, Main Generating Station.

air-compressor motors. In addition to the main load, the Interstate Light & Power Company supplies energy for lamps and motors in Galena, Ill., Hazel Green, Cuba City, Benton and Platteville, Wis. The scope of the present transmission system is illustrated by the accompanying map, which shows the location of mines and towns served from the substations at Hazel Green, Cuba City and Platteville. The 33,000-volt transmission line is represented by a heavy solid line; the 2300-4000-volt secondaries by dotted lines. Various operating mining properties in the region traversed by the lines are indicated by small circles; those equipped with electric drive being blacked in solid.

GENERATING STATION.

The generating station is located about one-half mile below the city of Galena, on the north bank of the Galena or Fever River, a navigable stream formerly of considerable commercial importance. The power-house site is on the side of a gentle slope which naturally adapts it for the convenient entry and storage of coal, a railroad switch connection, 14 ft. above the boiler-room floor, being made with all of the four principal freight lines entering the city. The station itself is a concrete, brick and steel structure. The engine-room parallels the boiler-room, while at the east end of the engine-room, and opening into it, is the electrical switching and transformer

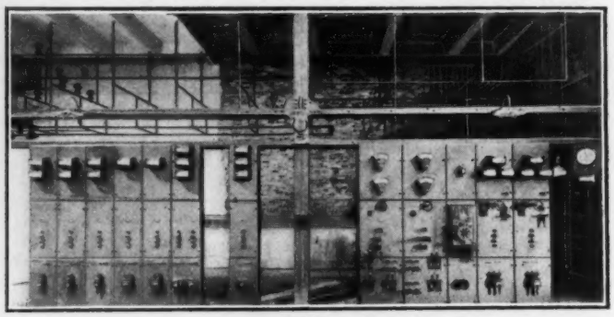


Fig. 5—Switchboard, Main Generating Station.

house. The remaining portion of the incomplete rough square formed by these buildings is occupied by the water-purification system. Provision has been made for doubling the present station capacity by adding two more units, extending the engine and boiler-rooms on the west, the present switching compartment having been designed with this addition in view.

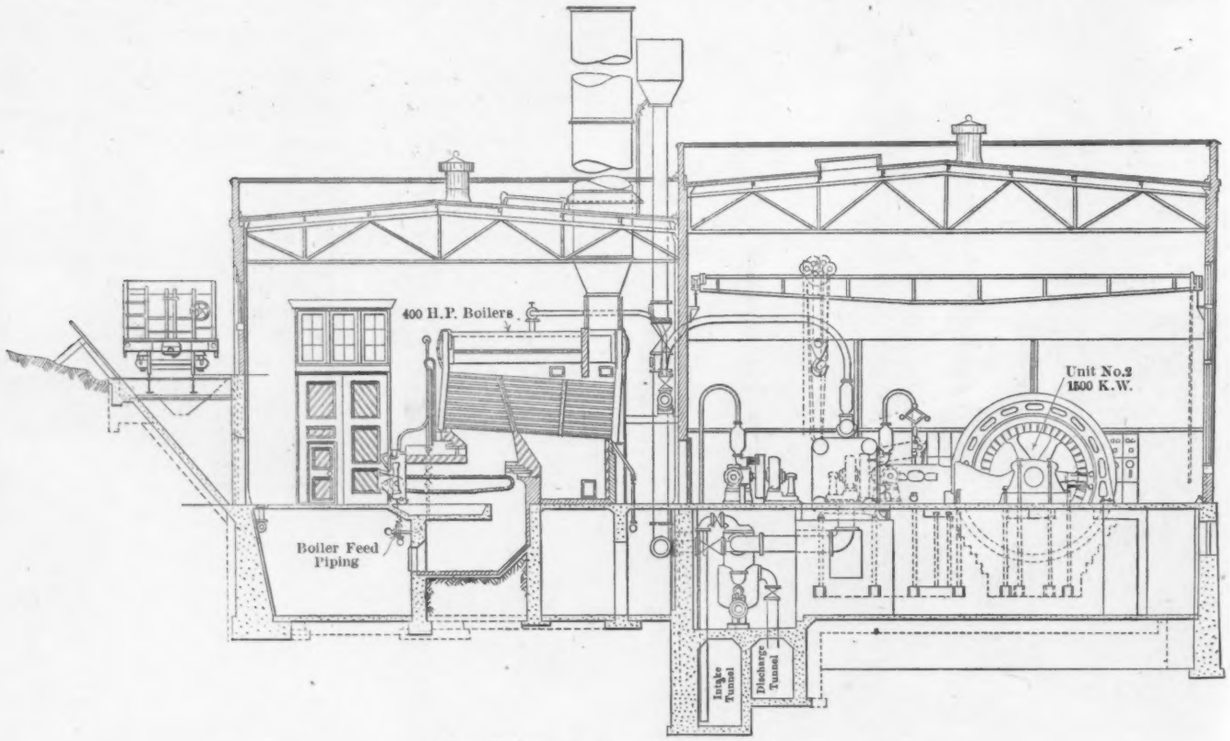


Fig. 4—Cross-Section of Power House.

Architecturally, the station exterior is relieved by the attractive arrangement of windows and cornice. The engine-room interior, including both brick and steel work, will be finished in white.

The main generating equipment comprises two Allis-Chalmers heavy-duty, cross-compound Corliss engines driving

2300-volt, 60-cycle, three-phase General Electric alternators; one a 1250-kw unit and the other a 1500-kw unit. The exciter equipment, which is all steam driven, comprises two direct-

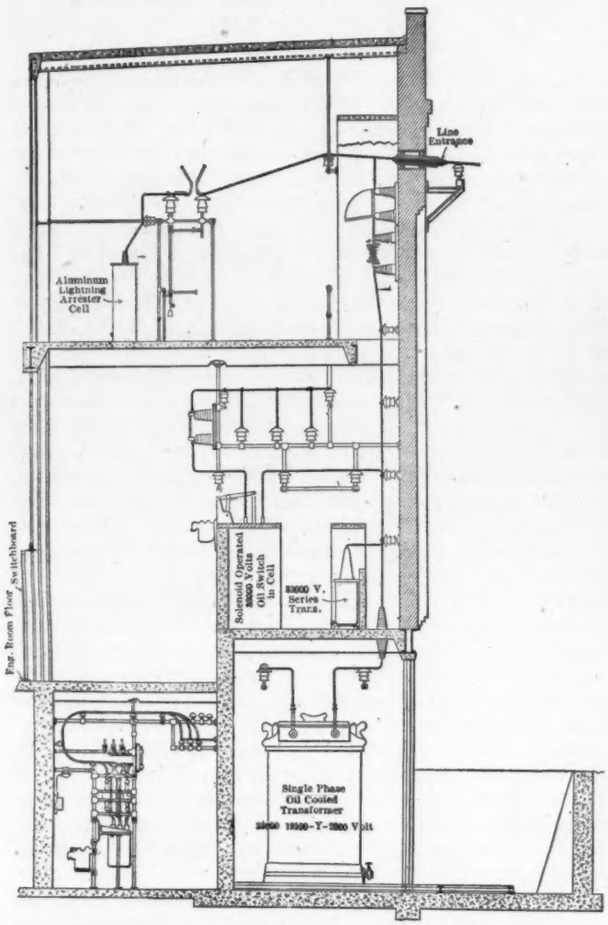


Fig. 6—Section Through Switch House, Galena Generating Station.

connected sets of Ridgway engines driving 50-kw, 125-volt General Electric direct-current generators at 300 r.p.m.

Loaded coal cars are run in from the railroad switch over

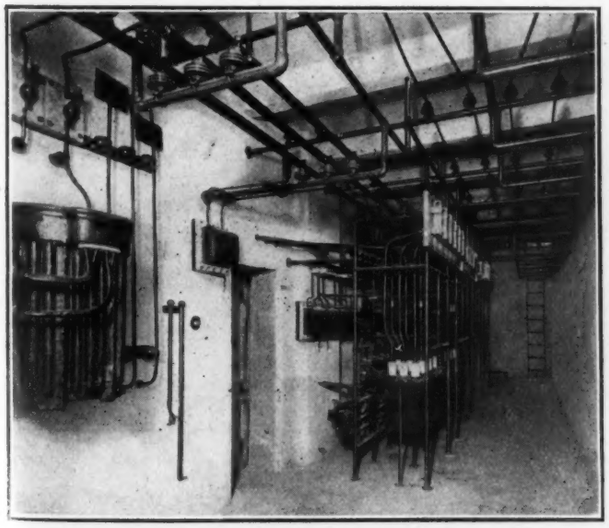


Fig. 7—Low Tension Oil Switch Room, Main Station.

concrete coal bins, which form one side of the boiler-room, opposite the furnaces. These bins have a capacity of about 10 carloads, or 330 tons, while outside storage for large quantities of coal is provided by the 10 acres included in the power-house plot. One of the six track hoppers is equipped with a Jeffrey coal crusher, driven by a 25-hp, 220-volt, three-phase motor. The future station plans provide for overhead steel-and-concrete coal bunkers which are to be installed when the anticipated extension of the station is made. At present the coal is wheeled to the four 400-hp Edgemoor boilers, which are equipped with Green automatic chain grates, driven by one of the duplicate steam engines, from the pits below the furnaces; the ashes are raked into dump cars, from which a bucket conveyor raises them to the empty coal cars. There are two an-

Fig. 8—33000-Volt Switches and Compartments.

chored steel smoke stacks, each 6 ft. 6 in. in diameter and 138 ft. high, one stack serving each pair of boilers.

Boiler-feed water is taken from the Galena River, 200 ft. distant, through a reinforced concrete-lined tunnel having i entry fitted with screens and a protecting rack. This tunnel is led under the engine-room, where it parallels a discharge tunnel which conveys the condenser discharge and plant drainage back to the river at a point below. Duplicate steam-driven service pumps, controlled by a float governor in the purifier tank, deliver the raw river water to be treated for boiler-feed purposes to a 65,000-gal. Northern water-softener apparatus which has a capacity of 15,000 gal. hourly. After this water has received the proper proportions of soda ash and milk of lime in the purifier, a flexible system of piping is provided by which the boiler-feed pumps may take their supply directly from the softener tank, from the feed-water heater or from the service pumps. The boiler-feed mains are in duplicate, each boiler comprising a closed loop across the pair. For compactness, the feed-water heater is mounted on a platform directly over the boiler pumps in the boiler-room.

The high-pressure cylinders of the prime movers are placed adjacent for convenience in handling the throttles, while gage boards indicating the various pressures are mounted in easy view of the operator's station. The engine low-pressure cylinders exhaust into Dean jet-type condensers, which discharge into the tunnel returning to the river. Condensation from all live-steam traps is delivered to the feed-water heater.

All of the station switching is done through auxiliary circuits from a remote-control vertical board mounted at the east end of the engine-room. This board comprises the generator panels, with ammeters, voltmeters and indicating wattmeters;

exciter panels, with ammeters and voltmeters, regulator panel, with Tirrill automatic field regulator, and the 2300-volt and 33,000-volt bus and line panels. A synchroscope and frequency indicator are provided on a swinging bracket for aid in paralleling machines. Provision has been made for extending this switchboard to serve the designed additions to the plant equipment and buildings.

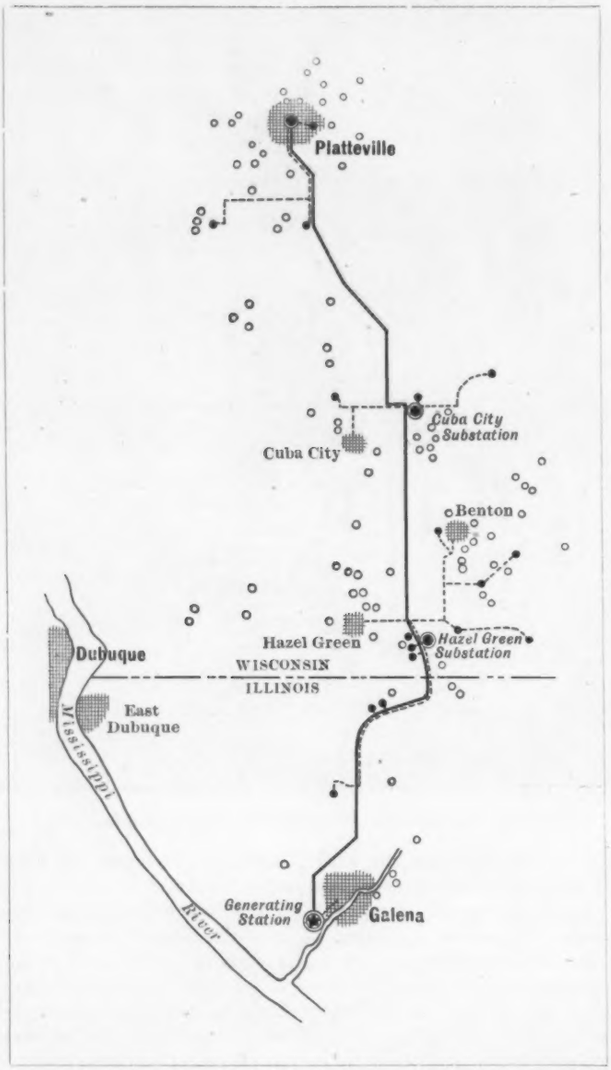


Fig. 9—Map of Transmission System, Showing Zinc Mines Served.

The main station transformers are mounted on the basement level in individual concrete compartments, 8 ft. 4 in. wide, 13 ft. 9 in. high and 10 ft. deep, opening only to the outdoor area way through steel roller fire doors. For stepping-up the generator bus voltage to the transmission potential of 33,000 volts three 500-kw General Electric self-cooling, oil-insulated transformers are installed, each transformer being connected to form a leg of the 33,000 volt Y, with 19,100 volts across its terminals. A fourth transformer is held in reserve. On the engine-room floor level of the switchhouse are mounted 33,000-volt solenoid-operated oil switches, together with the high-tension transformers, while in the gallery above, opposite the line entries, are the line choke coils and horn-gaps and aluminum-cell lightning arresters. The 2300-volt switching to the station buses and to the feeders supplying the city of Galena is performed by solenoid-operated oil switches installed on the ground-floor level. Here there are also provided two General Electric 50-lamp, 6.6-amp constant-current transformers for supplying energy to the street arc lamps in Galena. The energy for station lighting and the auxiliary motors, all of which are of the alternating-current type, is supplied through a group of 2300-220-volt transformers, installed at the basement level.

TRANSMISSION LINES AND SUBSTATIONS.

The transmission line, which runs north from the Galena generating station to the Hazel Green, Cuba City and Platteville substations, comprises 26 miles of 33,000-volt, single-circuit, three-phase pole-line construction. From the transforming substations about 27 miles of 2300-4000-volt secondaries lead to the outlying mines and villages, approximately five or six miles of these circuits being carried along on the same poles with the 33,000-volt primaries. For both primaries and secondaries No. 1 stranded aluminum cable, equivalent in conductivity to No. 3 copper, is employed. The standard 33,000-volt construction employs 35-ft. poles, carrying 2-ft. and 5-ft. cross-arms which sustain the conductors on Locke 40,000-volt insulators at a triangular distance of 52 in. Angle irons 3 ft. long carry the ground wire of ¼-in. stranded steel cable, 26 in. above the top conductor. Under the same J-bolt which supports this cable at each pole a No. 4 galvanized-iron ground wire is clamped, extending down the pole, to which it is stapled every 3 ft., and ending in a grounded coil under the pole butt. The main transmission poles also carry a telephone circuit connecting the various stations. These poles are set at an average spacing of 150 ft.

The high-tension line was not laid without reference to the topographic features of the country, but for the purpose of keeping the main line close to the present and probable future centers of distribution. That is the reason why the line veers easterly as it leaves Galena and then turns northwesterly from Cuba City to Platteville.

The Hazel Green and Cuba City substations are practically identical, being yellow brick structures, 33 ft. x 25 ft., and 31 ft. high. The Platteville substation proper is slightly larger, having been modified to become a part of the new local office building of the company. All substation floors and partitions are of concrete.

At the Hazel Green and Cuba City substations the 33,000-volt line is looped through the station, provision being made for oil switches disconnecting both the incoming and outgoing circuits. The three 250-kw, 33,000-2300-volt station transformers, with a fourth spare unit, are installed in separate concrete cells opening only to the outer areaway through roller-type steel doors. They are connected to the 33,000-volt buses by a solenoid-operated oil switch, controlled from the panel board on the first floor. The horn-gaps are mounted on the substation roof.

Fig. 10—Transmission Line Pole, Showing Ground, Primary, Secondary and Telephone Wires.

from which their discharge wires enter the rear wall to the aluminum-cell lightning arresters installed on the second floor. On the lower floor are the hand-operated oil switches controlling the various 2300-4000-volt secondaries which leave the station through entries in the side walls, all front and rear entries being reserved for high-tension wires.

ELECTRICAL OPERATION OF MINES.

In southwest Wisconsin and northwest Illinois, lead mining has been carried on for a great many years, during most of which time this metal was considered the only valuable mineral. The rich deposits of galena or lead sulphide—much of it almost pure metallic lead—lay near the surface and were easily recovered by a little digging of the top soil. The earlier miners never penetrated below the water level, since they had no means of handling the flow. Later, the Cornish type of lift pumps were introduced into this field and thus opened up the great deposits of "black-jack," or zinc sulphide, which had been denied the earlier miners.

The 1909 production of concentrates from this field was 75,000 tons, and promises in 1910 to exceed 100,000 tons, assuming the same rate of growth as in preceding years. The average price received for this material varies from $25 to $40, depending upon the character of the concentrate. The present veins are mined at a depth of about 100 ft. to 140 ft., and produce a zinc-sulphide ore that has as its impurities usually iron pyrites and lime. A small amount of zinc is also found in the form of the carbonate. The total quantity of lead now produced in this field, which covers about 1000 sq. miles of the State of Wisconsin, amounts to approximately one-fifteenth of the total zinc production.

The zinc deposits are of a reliable nature and the indications are that with the opening of mines from year to year there will be a consistent and satisfactory growth in production in the district. Already the Mineral Point Zinc Company, a part of the New Jersey Zinc Company; the Wisconsin Zinc Company, a subsidiary of the American Zinc & Lead Smelting Company, of Boston; the Vinegar Hill Zinc Company interests, and the Frontier Mining Company, all of which are heavy operators in other fields, have extensive mine properties in this district, the permanency of which as continuous producers of zinc ore is unquestioned.

In the process of mining and the preparation of the concentrate, the ore-bearing rock, after being hoisted from the shaft, is first crushed in an oscillating-jaw crusher and is then further reduced by passing between heavy spring-seated rolls. Such material as is then ready to pass through the sizing screens without further crushing is elevated to the roughing jig, in the cells of which it is rapidly oscillated in the presence of a rapidly flowing stream of water which carries off the lighter particles of stone, while the heavy ores settle to the bottom, the lead separating out in the first one or two cells. The concentrate of this jig is again crushed and led to the smoothing jig, where it undergoes a similar process as before, the product of this action being the commercial concentrate. Sometimes the sluice water from this jig, containing fine ore material in suspension is passed to a third set of sand jigs,

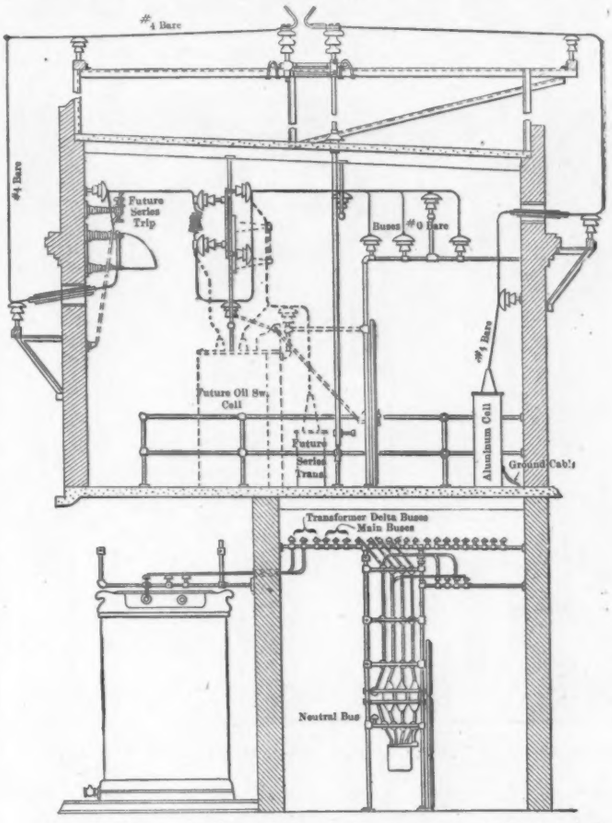


Fig. 12—Cross-Section Through Hazel Green Substation.

where a final separation is carried out. Sludge or concentrating tables, which are oscillated slightly while the tail-water is flowed over them, thus aiding in precipitating the entrained ore material, are sometimes also used in this field. Following the above processes, which depend upon the differing specific gravities of the materials separated, the iron pyrites in the concentrates must be removed by some other method, usually magnetic or electrostatic. The final zinc-ore concentrates usually comprise about 10 per cent of the "rock" treated.

The average mill in the Wisconsin district has a capacity for treating 100 tons of rock per eight hours, and heretofore each mill has necessarily required its own steam-power plant, usually rated at from 200 hp to 250 hp. With the coming of electric service this equipment, representing an investment of perhaps $8,000, has been supplanted by electric motors of one-third the cost. To obtain the convenience and advantages of electric drive, it is interesting to note that in several cases comparatively new Corliss engines have been replaced, and a number of new mines are now opening up with provision for no other drive than motors. All the mine motors on the lines of the Interstate company are of the 220-volt, 60-cycle, alternating-current type, receiving their energy from the 2300-volt secondaries through a group of 50 or 75-kw transformers installed on the customers' premises.

The average motor equipment for the electric drive of a mine in the Wisconsin district is made up as shown by the following figures: For hoisting purposes, raising buckets containing from 800 to 1500 lb. of rock, from depths of 140 to 240 ft., and at speeds of 600 to 1200 ft. per minute, which is the common practice in this region, motors rated at from 37 to 52

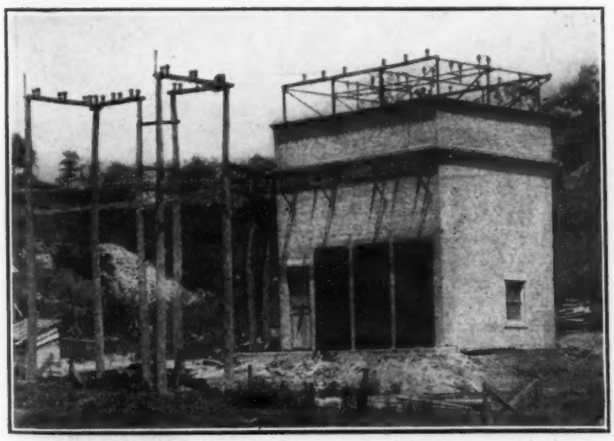


Fig. 11—Hazel Green Substation.

hp are required. This hoisting work continues during two shifts, or about 16 hours per day.

For the mill itself, group drive, a relic of steam operation, is the general rule. The "bull" or main motor for this service is usually of 100 or 75-hp capacity, and drives, from the mill shaft, four or five elevators and conveyors, of the bucket or belt type; a centrifugal pump for supplying the "mill water" used for sluicing the "dirt" through the various mill processes; three or four seven-cell jigs, one jaw crusher, three roll

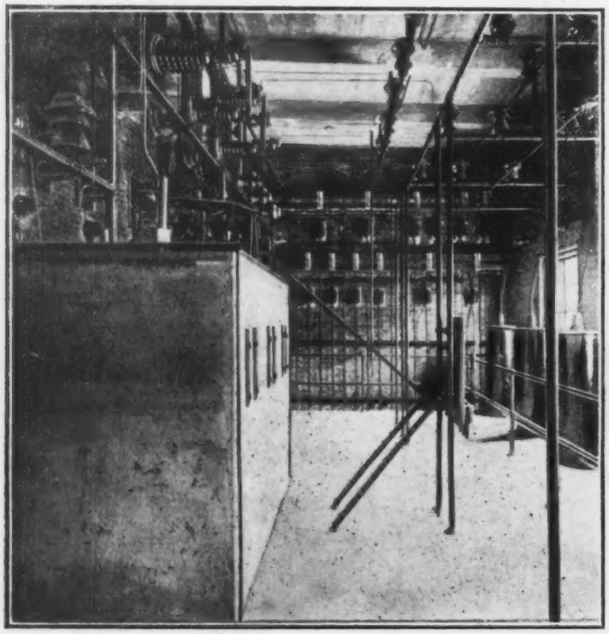


Fig. 13—High Tension Switch Room, Hazel Green Substation.

crushers, two revolving screens, and sometimes one or two sluice tables. This also comprises a 16-hour load, working through two shifts.

The pumps used to free the mine of water run 24 hours a day and discharge 500 to 2000 gal. per minute against a head of 100 to 200 ft. For driving the great Cornish lift pumps which have long represented standard practice in the Wisconsin district, a variable-speed motor of 35 to 50-hp rating may be used, where at times it is desirable to secure partial loads on the pump. However, the use of centrifugal pumps driven by direct-coupled motors is being strongly advised on account of their lower expense for maintenance. Several have been in use for this purpose and have shown their excellent performance under these conditions.

The drive of the air-compressors, 16 hours per day, will require a 75 or 100-hp motor for supplying the compressed air used by five or six pneumatic drills employed at the workings in preparing for blasting. With the availability of electricity, the motor-operated drill is now coming to be appreciated in this section, especially when its consumption of 1½ to 5 hp per drill, is compared with the 15 to 20 hp per drill required to drive a compressed-air outfit.

For removing the iron from the concentrates and thus increasing the value of the ore, several mines also treat their output by the roaster process, by which the iron pyrites are converted into iron oxide, which is then picked out by magnets. In this process, after first traversing special small roll-type crushers, the granulated ore is passed through the roasting kiln. This is a large, clay-lined cylinder, 5 ft. in diameter and 16 ft. long, slightly inclined to aid in the flow of the ore. It is slowly rotated about its axis once a minute, by a 10-hp motor, while its interior is heated to incandescence by the passage of the hot flue gases from a fire box at the lower end. The ore passing through this high temperature has all its pyrites reduced to iron oxide, which is then picked out by magnets.

Two schemes of electromagnetic separation are in use in this field, differing only in the arrangement of the magnets. One employs a rotating electromagnet with a central and annular pole-piece, which is pivoted over the concentrates being carried past on a conveyor belt. The magnetic material is attracted and held in the gap between the poles, from which it is removed by a brass scraper as the rotation of the magnet carries it to one side. Another method utilizes a number of soft-iron pole pieces set in the periphery of a wheel rotated over a vibrating incline which the concentrates descend. At a point directly over the stream of material is a large electromagnet, which imparts its magnetism to the soft-iron pole pieces, causing them to pick up and carry the magnetic material to one side, where, the induced magnetism of the poles dying away, their loads are dropped into pans at the side of the belt. The electromagnets for these separation processes require from 3 to 7 amp., direct current, at 110 volts. Small motor-generator sets are provided to supply them from the 60-cycle energy of the

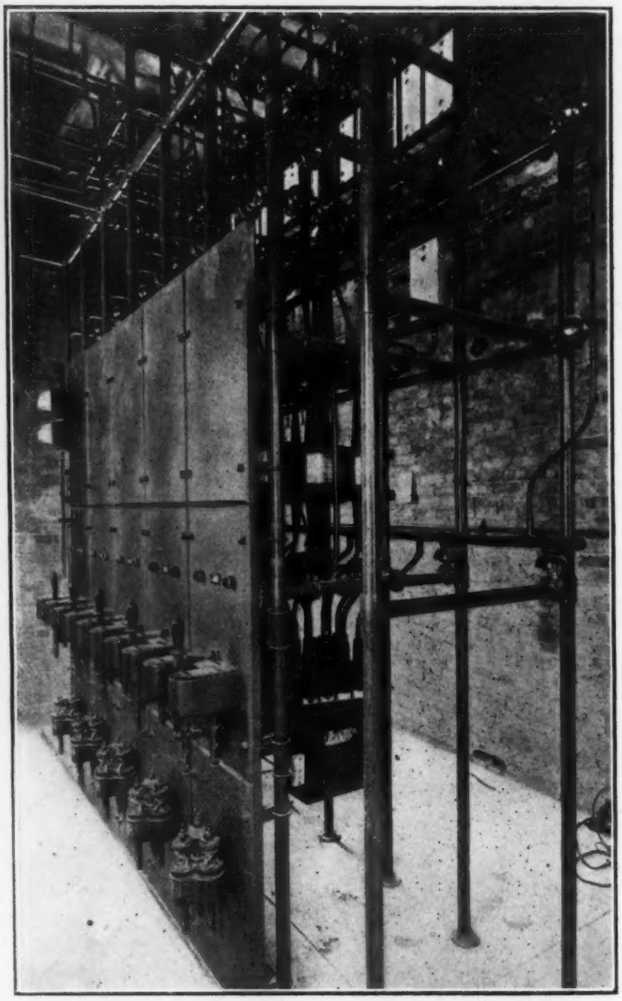


Fig. 14—Low Tension Switch Room, Hazel Green Substation.

transmission system. No commercial use is made of the iron oxide removed in the separation process, and large banks of the material are in evidence about each roaster house.

Another local method of electrical separation of pyrites from the concentrates, which avoids roasting the ore, employs static charges approximating a potential of 35,000 volts. Sixty-cycle alternating current is stepped up by special transformers to a pressure of 25,000 volts, being then led through a commutator on a synchronous shaft, which rectifies it to a unidirectional

potential. This is used to charge attraction plates mounted in front of thin streams of the concentrate, which has previously been thoroughly dried. The attraction of the static charges on the iron pyrites deflects this material out of the line of the falling concentrate, where it is caught by a sharp dividing partition and delivered to a separate compartment. The process is repeated a number of times before the separation is complete, because if too strong an attractive charge is used, considerable ore may be pulled over along with the iron, and vice versa. One plant, utilizing the electrostatic method, in the Platteville district, has a capacity for separating 60 to 75 tons per day.

The commercial value of separating the pyrites from the ore

Fig. 15—Secondary Entry to Zinc Mining Property.

by some process or other will readily be appreciated, if 30 per cent. ore, having a value of $15 a ton, can by this means be converted to 60 per cent. ore, bringing a price of $44. However, more than two tons of the former quality are evidently required to make one ton of the high-grade concentrate, and there are, of course, other losses and expenses of operation to be considered. Besides the loads already described, the lighting of the average mine property requires about 100 16 cp incandescent lamps. Nearly half of these are used underground for lighting the shaft, passages and working chambers, the remainder being required in the mill.

Much of the foregoing load is operated 16 to 24 hours per day, representing an average monthly consumption of from 50,000 to 60,000 kw-hours for a typical mine, or a load factor of about 50 per cent. for the system. The transmission system of the Interstate Light and Power Company went into service with a connected load of about 3500 hp in motors, divided among 15 mines, but this number is being added to from week to week. The accompanying map of the field shows the great number of mine properties scattered through the region traversed by the Interstate company's lines, many of which are prospective users of electrical energy. The total connected load of the present largest mine installation of the system is 275 hp.

Energy is sold to the mine customers in this field at a rate beginning at 8 cents for all consumed under 100 kw-hours per month, and scaling down to 2 cents for all in excess of 80,000 kw-hours. Readings of the customers' consumption are taken by watt-hour meters on the low-tension side of the 2300-220-volt transformers, which, like the meters, are the property of the electric lighting company. A minimum charge is made of $1 per month per hp of connected load. Thus the average rate secured by a typical mine installation consuming from 50,000 to 60,000 kw-hours monthly will be about 2.7 cents per kw-hour.

With the local excessive price of coal in the field, after extra freight charges and wagon haulage have been paid, it has been shown to be impossible to develop similar quantities of energy at the isolated mine plants for less than 4 or 4.5 cents per kw-hour. Thus, aside from the freedom from shipment delays and plant attention and breakdown, the electrically-operated mine is capable of securing an operating economy of several thousand dollars per year by a change in motive power from steam to electricity, at the same time liberating itself from the capital charges on the expensive steam equipment.

The Interstate Light and Power Company supplies the commercial lighting over its own distribution system in the towns of Galena, Ill. (population 8000), and Platteville, Wis. (7000), and wholesale energy to the villages of Hazel Green (600), Cuba City (1400), and Benton (1000), for resale among the local consumers. The latter service is supplied at the same rate to the villages as to the individual mines above mentioned. In several of these villages the water is pumped by electricity.

About 300 consumers are now connected to the Galena 60-cycle distribution system, including practically every store in the town. This fact is of some special interest, as commercial electric service was first inaugurated in Galena only a year ago, when the present company took over the municipal arc-lighting plant, and added modern alternating-current generating machinery for the commercial load. Until the present transmission system was completed, Galena's lighting was obtained from this 200-kw station. The use of electric signs, window displays, heating appliances, electric fans, etc., is pushed in a progressive manner in both Galena and Platteville, in each of which the company maintains attractive offices and showrooms. The present total connected load in Galena is about 250 kw., and in Platteville 450 kw. Platteville was formerly served with direct current by a 200-kw generating station. The company furnishes series arc street lighting in both places, and series incandescent lighting in Platteville. The customers' rate per kw-hour is 15 cents for the first 20 kw-hours per month, 12

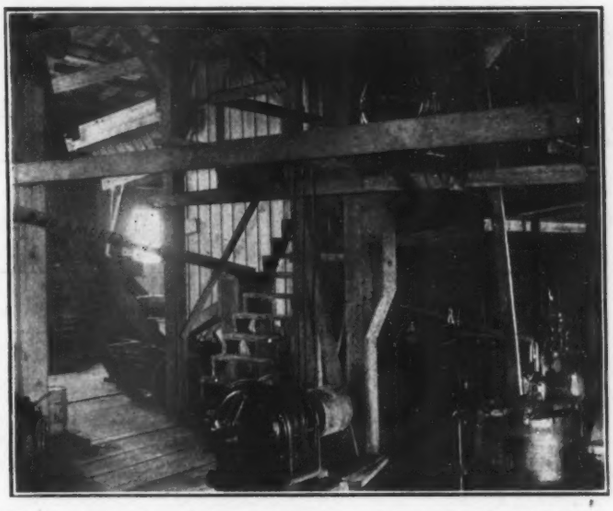


Fig. 16—Interior of Mine Property Arranged for Electric Drive.

cents for the next 30 kw-hours, 10 cents for the next 40 kw-hours, and 8 cents for all used in excess of 100 kw-hours. Bills thus computed are subject to 10 per cent. discount if paid within ten days. The minimum monthly charge is $1. No free lamps or renewals are included under the above schedule. Motor users obtain the rates already cited in the case of the mine services.

For the power-plant and transmission equipment of the Interstate Light and Power Company, Messrs. H. M. Byllesby & Company acted as engineers, Mr. Lincoln Nissley being resident engineer in charge of construction. The officers of the Interstate Light and Power Company are: President: Mr. A. O. Fox; vice-presidents, Messrs. George B. Caldwell, M. S. Sickle and Otto E. Osthoff; secretary, Mr. Morris F. Fox; treasurer, Mr. L. E. Caldwell; general manager, Mr. F. F. Espenschied.

SYMBOLIC ALTERNATING-CURRENT EQUATIONS.

The General Expressions for Relations in Alternating-Current Circuits.

By G. E. Marsh.

THE complex variable provides the most universally applicable means for the numerical computation of alternating-current quantities. In addition to the unequaled accuracy of the method there is usually a saving of time which in some cases is of considerable importance. For complicated networks the method of the complex variable stands alone in the matter of utility, though for simple circuits its advantages are not so pronounced and unless the question of accuracy in results is foremost, its employment becomes a matter of choice.

The expressions are perfectly general and are applicable with proper interpretation to all circuits practically regardless of the distribution of the impedance and of its value. They apply in all generality to circuits having any combination of resistances, inductances and capacities. There has been considerable opposition to this method of dealing with circuit problems and, therefore, it is not as widely used as it should be, and the writer believes that a hasty review of the general equations will be of value to those not already familiar with the use of complex quantities. In the following cases the mutual induction which may be present is considered negligible. The numbered expressions are available for the purposes of numerical computation.

The symbols have the following significance:

E_o = e.m.f. impressed on line; I_o = current in line; r = resistance in ohms; x = reactance in ohms, $= \left(2\pi fL - \frac{1}{2\pi fC}\right)$ and E_r = P.D. or drop across the rth impedance.

The inductance, L, capacity, C, and frequency, f, are expressed in henrys, farads and cycles per second respectively. The conductance is $g = r \div (r^2 + x^2)$, and the susceptance is $b = x \div (r^2 + r^2)$.

The subscript r is used to designate the expression for the general term of the type under consideration.

Case of M Impedances in Series.

The usual notation of the complex variable as adapted to alternate-current considerations will be followed and we evidently have

$$\left.\begin{aligned} E_1 &= (r_1 + jx_1)\, I_o, \\ E_2 &= (r_2 + jx_2)\, I_o, \\ &\cdots\cdots\cdots\cdots \\ E_r &= (r_r + jx_r)\, I_o, \\ &\cdots\cdots\cdots\cdots \\ E_m &= (r_m + jx_m)\, I_o, \end{aligned}\right\} \quad (a)$$

and vectorially,

$$E_o = E_1 + E_2 + \ldots\ldots + E_r + \ldots\ldots E_m. \quad (b)$$

Introducing the right-hand side of equations (a) in equation (b),

$$\begin{aligned} E_o &= I_o\,[\,(r_1 + r_2 + \ldots\ldots + r_m) + j\,(x_1 + x_2 + \ldots\ldots + x_m)\,], \\ &= I_o\,(\Sigma m_1 r + j\,\Sigma m_1 x). \end{aligned} \quad (c)$$

It is to be understood that the symbol Σm_1 stands for the operation of taking the sum of the M resistances in the first instance and of the M reactances in the second; that is, $\Sigma m_1 r = (r_1 + r_2 + \ldots\ldots + r_m)$.

The numerical value of E_o is given by the square root of the sum of the squares of the two components, namely, by

$$E_o = I_o \sqrt{(\Sigma m_1 r)^2 + (\Sigma m_1 x)^2}. \quad (1)$$

Further, we clearly have from equations (a) and (c)

$$E_r = \frac{E_o\,(r_r + jx_r)}{\Sigma m_1 r + j\,\Sigma m_1 x}$$

and this gives on separation into the two components and taking the square root of the sum of their squares, the expression suitable for purposes of computation:

$$E_r = \frac{E_o \sqrt{r_r^2 + x_r^2}}{\sqrt{(\Sigma m_1 r)^2 + (\Sigma m_1 x)^2}} \quad (2)$$

The angle of phase difference between the potential drop across the rth impedance and the current in it is given by

$$\tan \Theta_r = \frac{x_r}{r_r}, \quad (3)$$

and similarly for the phase angle between E_o and I_o,

$$\tan \Theta_o = \frac{\Sigma m_1 x}{\Sigma m_1 r}. \quad (4)$$

Case of M Impedances in Parallel.

In the nomenclature of the complex quantity as applied to parallel circuits we have as the expressions for the currents in the several branches,

$$\left.\begin{aligned} i_1 &= (g_1 - jb_1)\, E_o, \\ i_2 &= (g_2 - jb_2)\, E_o, \\ &\cdots\cdots\cdots\cdots \\ i_r &= (g_r - jb_r)\, E_o, \end{aligned}\right\} \quad (d)$$

and vectorially,

$$I_o = i_1 + i_2 + i_3 + \ldots\ldots + i_m. \quad (e)$$

Combining equations (d) and (e) there results directly

$$I_o = E_o\,(\Sigma m_1 g - j\,\Sigma m_1 b),$$

and hence

$$I_o = E_o \sqrt{(\Sigma m_1 g)^2 + (\Sigma m_1 b)^2}. \quad (5)$$

Similarly,

$$i_r = \frac{I_o\,(g_r - j\,b_r)}{\Sigma m_1 g - j\,\Sigma m_1 b}$$

and for numerical purposes

$$i_r = \frac{I_o}{(E_g)^2 + (E_b)^2} \times \sqrt{(g_r\,\Sigma m_1 g + b_r\,\Sigma m_1 b)^2 + (b_r\,\Sigma m_1 g - g_r\,\Sigma m_1 b)^2}. \quad (6)$$

The values of the phase angles in the case of the rth impedance, that is, the angle between E_o and i_r, and in the case of E_o and I_o are given respectively by

$$\tan \Theta_r = \frac{x_r}{r_r}, \quad (7) \text{ and } \tan \Theta_o = \frac{\Sigma m_1 b}{\Sigma m_1 g} \quad (8)$$

Case of Series Parallel Circuits.

Let there be a groups of divided circuits in series and let the number of paths in parallel in each group be $n_1, n_2, \ldots\ldots n_a$, respectively. Further, let ${}_1i_1, {}_2i_1 \ldots\ldots {}_{n1}i_1$ represent the currents in the several branches of the first group, and similarly ${}_1i_r, {}_2i_r, \ldots\ldots {}_{nr}i_r$, the currents in the rth group. If the drops across the several groups be given by $E_1, E_2, \ldots\ldots E_a$, respectively, we may write at once

$$E_1 = \frac{{}_1i_1}{{}_1g_1 - j\,{}_1b_1} = \frac{{}_2i_1}{{}_2g_1 - j\,{}_2b_1} = \ldots\ldots \frac{{}_{n1}i_1}{{}_{n1}g_1 - j\,{}_{n1}b_1},$$

$$\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots$$

$$E_r = \frac{{}_1i_r}{{}_1g_r - j\,{}_1b_r} = \frac{{}_2i_r}{{}_2g_r - j\,{}_2b_r} = \ldots\ldots \frac{{}_{nr}i_1}{{}_{nr}g_r - j\,{}_{nr}b_r},$$

Since

$$\begin{aligned} I_o &= {}_1i_1 + {}_2i_1 + \ldots\ldots + {}_{n1}i_1, \\ &= {}_1i_2 + {}_2i_2 + \ldots\ldots + {}_{n2}i_2, \\ &\cdots\cdots\cdots\cdots\cdots\cdots \\ &= {}_1i_r + {}_2i_r + \ldots\ldots + {}_{nr}i_r, \end{aligned}$$

we have directly

$$\begin{aligned} I_o &= E_1\,[\,({}_1g_1 - j\,{}_1b_1) + ({}_2g_1 - j\,{}_2b_1) + \ldots\ldots ({}_{n1}g_1 - j\,{}_{n1}b_1)\,], \\ &\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots \\ &= E_r\,[\,({}_1g_r - j\,{}_1b_r) + ({}_2g_r - j\,{}_2b_r) + \ldots\ldots ({}_{nr}g_r - j\,{}_{nr}b_r)\,]. \end{aligned}$$

From the last equation, taking it as a typical one,

$$I_o = E_r\,[\Sigma {}^{nr}{}_1 g_r - j\,\Sigma {}^{nr}{}_1 b_r],$$

or for the purpose of numerical calculation we have

$$I_o = E_r \sqrt{(\Sigma {}^{nr}{}_1 g_r)^2 + (\Sigma {}^{nr}{}_1 b_r)^2}. \quad (9)$$

The angle between ${}_{n}i_r$ and E_r, that is, the angle between the current in the nth branch of the rth group and the drop across that group is given by

$$\tan {}_n\Theta_r = \frac{{}_nx_r}{{}_nr_r} \quad (10)$$

and similarly the angle between E_r and I_o is given by

$$\tan \Theta_r = \frac{\Sigma {}^{nr}{}_1 b_r}{\Sigma {}^{nr}{}_1 g_r} \quad (11)$$

Equation (9) permits the calculation of the total or line current when the electrical constants and drop for any one group are known. If the current and constants are known the drop may be found. In the last expression, and in those that follow, it is to be understood that the summation symbol,

given by $\Sigma^{nr}{}_1 b_r$, for example, represents the sum of the various quantities, in the rth group, viz. $({}_1b_r + {}_2b_r + {}_3b_r + \ldots\ldots {}_nb_r)$.

The impressed voltage is given by the vector equation

$$E_o = E_1 + E_2 + \ldots\ldots + E_a,$$

$$E_o = I_o\left[\frac{1}{\Sigma^{n^1}{}_1 g_1 - j\,\Sigma^{n^1}{}_1 b_1} + \frac{1}{\Sigma^{n^2}{}_1 g_2 - j\,\Sigma^{n^2}{}_1 b_2} + \ldots\ldots \frac{1}{\Sigma^{na}{}_1 g_a - j\,\Sigma^{na}{}_1 b_a}\right].$$

If the quantities $\Sigma_1{}^{n^1} g_1$, $\Sigma_1{}^{n^1} b_1$, $\Sigma_1{}^{n^2} g_2$, etc., be replaced by G_1, B_1, G_2, etc., for the purpose of simplification, then

$$E_o = I_o\left[\left(\frac{G_1}{G_1{}^2 + B_1{}^2} + \frac{G_2}{G_2{}^2 + B_2{}^2} + \ldots\ldots \frac{G_a}{G_a{}^2 + B_a{}^2}\right) + j\left(\frac{B_1}{G_1{}^2 + B_1{}^2} + \frac{B_2}{G_2{}^2 + B_2{}^2} + \ldots\ldots \frac{B_a}{G_a{}^2 + B_a{}^2}\right)\right]$$

and if the last expression be written

$$E_o = I_o[(G_1' + G_2' + \ldots . G_a') + j\,(B_1' + B_2' + \ldots . B_a')],$$

where the fractions have been replaced by the corresponding primed letters, we obtain

$$E_o = I_o\,[\Sigma_1{}^a G' + j\,\Sigma_1{}^a B'],$$

and

$$E_o = I_o \sqrt{(\Sigma_1{}^a G')^2 + (\Sigma_1{}^a B')^2}. \qquad (12)$$

And as before, it is understood that

$$\Sigma_1{}^a G' = G_1' + G_2' + G_3' + \ldots . G_a'; \text{ etc.}$$

If the line current is unknown then E_o or E_r may be determined from equations (9) and (12), as

$$E_o = E_r \sqrt{(\Sigma_1{}^{nr} g_r)^2 + (\Sigma_1{}^{nr} b_r)^2}\,\sqrt{(\Sigma_1{}^a G')^2 + (\Sigma_1{}^a B')^2}. \qquad (13)$$

Finally, tan Θ_o, the angle between E_o and I_o, is given by

$$\frac{\Sigma_1{}^a B'}{\Sigma_1{}^a G'} \qquad (14)$$

APPLICATION OF SYMBOLIC EQUATIONS.

The Solution of Problems Involving Star-Connected Three-Phase Circuits.

BY HARRY P. WOOD.

WHEN unbalanced loads on a three-phase circuit are connected in star, a fourth, or neutral, conductor is usually employed. Problems involving star connection of unbalanced loads without a neutral conductor are, however, very instructive, and the following solutions may be of interest to those who have experienced difficulty in getting a starting point for such problems. The method of complex quantities is used, keeping in mind the two fundamental laws for any network of conductors. These laws may be stated as follows:

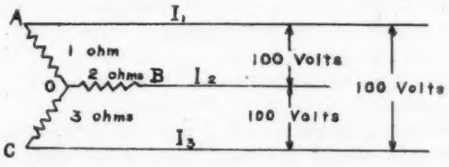


Fig. 1—Unbalanced Non-Inductive Load.

1. At any instant, the sum of the currents meeting in a point equals zero. 2. At any instant, the sum of the e.m.fs. forming a closed loop equals zero.

If a circuit is connected as shown (Fig. 1) with three non-inductive resistances of 1 ohm, 2 ohms and 3 ohms the current and voltage relations may be assumed, as shown in Fig. 2.

The triangle ABC is drawn with one side vertical. The sides AB, BC and CA represent the line voltages. In order to avoid complicated looking algebraic expressions the writer has assumed a definite value of 100 volts as the e.m.f. between each pair of conductors. It is desired to find the currents in conductors A, B and C and the voltages OA, OB and OC. The point O is assumed anywhere in the plane and the lines OA, OB and OC are drawn, representing the required voltages.

This diagram does not necessarily represent the actual conditions in the circuit, but, as seen later, if the point O is chosen wrong some of the co-ordinates will be negative when a solution is reached and a new and correct diagram can then be

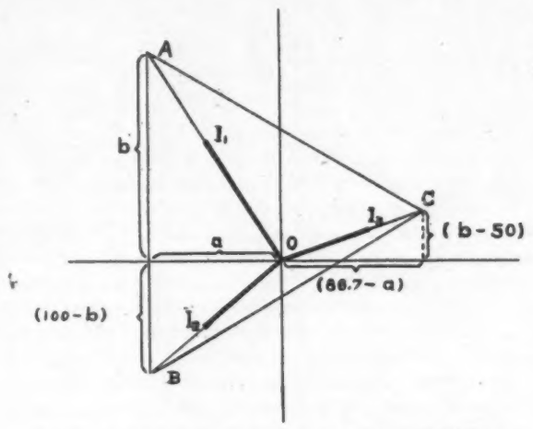


Fig. 2—Assumed Current and Voltage Relations.

constructed. With Fig. 2 as a reference, the following vector equations are written:

$$OA = -a + jb \qquad (1)$$

$$OB = -a - j\,(100 - b) \qquad (2)$$

$$OC = 86.7 - a + j\,(b - 50) \qquad (3)$$

In Fig. 2 the line OI_1 represents the current I_1, OI_2 represents the current I_2 and OI_3 represents the current I_3.

Since the currents I_1, I_2 and I_3 are in phase with the voltages OA, OB and OC, and the resistances are 1 ohm, 2 ohms and 3 ohms, respectively, the vector equations for the currents are:

$$I_1 = -a + jb, \qquad (4)$$

$$I_2 = -a/2 - j\,(100/2 - b/2), \qquad (5)$$

$$I_3 = 86.7/3 - a/3 + j\,(b/3 - 50/3). \qquad (6)$$

But since $I_1 + I_2 + I_3$ is zero, the sum of the horizontal components of I_1, I_2 and I_3 will equal zero and the sum of the vertical components will equal zero. Collecting all of the terms in

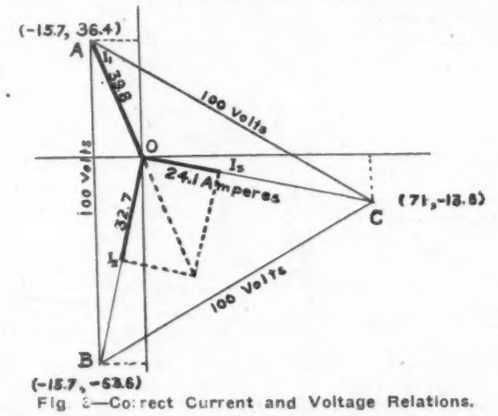


Fig. 3—Correct Current and Voltage Relations.

equations (4), (5) and (6) which do not contain the imaginary factor j and putting their sum equal to zero:

$$-a - a/2 + 86.7/3 - a/3 = 0; \qquad (7)$$

or, $a = 15.7$.

Likewise collecting all of the terms in equations (4), (5) and (6) which involve the imaginary factor j:

$$b - 50 + b/2 + b/3 - 50/3 = 0; \qquad (8)$$

or, $b = 36.4$.

If desired, Fig. 3 can now be plotted showing the correct relations. The numerical values determined analytically are as follows:

$$OA = \sqrt{(15.7)^2 + (36.4)^2} = 39.6 \text{ volts.}$$

$$OB = \sqrt{(15.7)^2 + (63.6)^2} = 65.5 \text{ volts.}$$

$$OC = \sqrt{(13.6)^2 + 71^2} = 72.3 \text{ volts.}$$

The currents in conductors A, B and C, respectively, are:

$$I_1 = \text{volts } OA \div 1 \text{ ohm} = 39.6 \text{ amp.}$$
$$I_2 = \text{volts } OB \div 2 \text{ ohms} = 32.7 \text{ amp.}$$
$$I_3 = \text{volts } OC \div 3 \text{ ohms} = 24.1 \text{ amp.}$$

A more general type of circuit is one which contains combinations of resistors and reactance coils and condensers. Fig. 4 shows such a circuit, in which it is desired to find the voltages OA, OB and OC and the currents I_1, I_2 and I_3.

A diagram similar to Fig. 2 is first made. AB, BC and CA

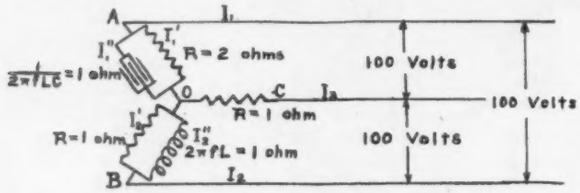


Fig. 4—General Case of Unbalanced Load.

are the line voltages, again taken as 100. OA, OB and OC are the required voltages. The current I_1 has two components, I_1' in phase with the voltage OA, and I_1'', which is 90 deg. in advance of OA. Similarly the current I_2 is composed of two currents, I_2' in phase with the voltage OB and I_2'' which is 90 deg. behind OB. The current I_3 is in phase with the pressure OC.

Referring to the connections shown in Fig. 4 and using Fig. 2 as a guide, the following vector equations may then be written:

$$OA = -a + jb \quad (1)$$
$$OB = -a - j\,(100 - b) \quad (2)$$
$$OC = 86.7 - a + j\,(b - 50) \quad (3)$$
$$I_1' = -a/2 + jb/2 \quad (4)$$
$$I_1'' = -ja - b \quad (5)$$
$$I_1 = -a/2 - b + j\,(b/2 - a) \quad (6)$$
$$I_2' = -a - j\,(100 - b) \quad (7)$$
$$I_2'' = ja - 100 + b \quad (8)$$
$$I_2 = (-a - 100 + b) + j\,(a - 100 + b) \quad (9)$$
$$I_3 = 86.7 - a + j\,(b - 50) \quad (10)$$

Since $I_1 + I_2 + I_3$ equals zero, we can place the sum of the horizontal components of the vector equations (6), (9) and (10) equal to zero.

$$-a/2 - b - a - 100 + b + 86.7 - a = 0;$$

or, $a = -5.3$.

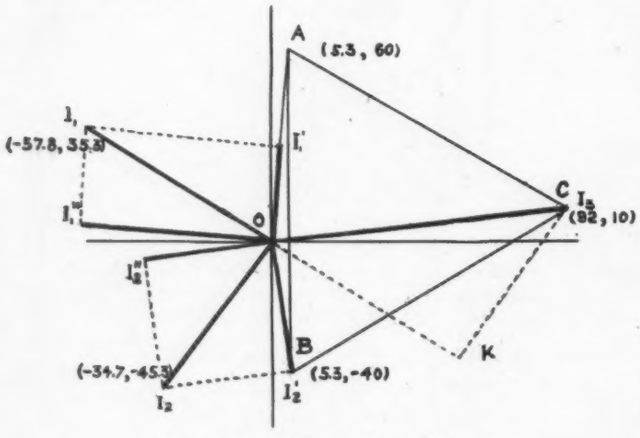


Fig. 5—Current and Voltage Relations.

Similarly, the sum of the vertical components,

$$b/2 - a + a - 100 + b + b - 50 = 0;$$

or, $b = 60$.

Fig. 5 can now be plotted to scale if we wish a graphical representation of the relations of the voltages and currents.

The actual values of the unknown quantities are as follows:

$$OA = \sqrt{5.3^2 + 60^2} = 60.2 \text{ volts}$$
$$OB = \sqrt{5.3^2 + 40^2} = 40.3 \text{ volts}$$
$$OC = \sqrt{92^2 + 10^2} = 92.5 \text{ volts}$$
$$I_1 = \sqrt{(5.3/2 - 60)^2 + (60/2 + 5.3)^2} = 67.5 \text{ amp}$$
$$I_2 = \sqrt{(5.3 - 100 + 60)^2 + (-5.3 - 100 + 60)^2} = 57.2 \text{ amp}$$
$$I_3 = \sqrt{(86.7 + 5.3)^2 + (60 - 50)^2} = 92.5 \text{ amp.}$$

In this case it is seen that the neutral point O falls outside the triangle which represents the line voltages.

After a solution is reached in any case, the results may be checked graphically, as shown in Fig. 5, by constructing a triangle, such as OKC, having the side OK equal and parallel to OI_1, and the side CK equal and parallel to OI_2. If the three sides close so as to form a triangle, it is an indication that the work is correct.

THE DESIGN OF FURNACE ELECTRODES.

Simple Rules for Proportioning the Electrodes for Minimum Loss.

By Carl Hering.

During the past year the writer investigated the question of the proper designing and proportioning of electrodes for electric furnaces so as to obtain the best economy of both power and material. These investigations showed that our former rules for calculating and designing electrodes were not only in large part inadequate, but even positively wrong and misleading, and they, moreover, gave us a false assurance that the proportions determined by those rules were correct. The result is that large quantities of expensive energy are being wasted annually which might in many cases have been saved had we known how to determine the correct proportions and to select the best materials.

The purpose of the present article is to describe the exceedingly simple method of calculating electrodes which is the final result of this long and tedious investigation. It is now so easy to determine what the proper proportions are, and the resulting saving in power, material and size of furnace, may be so great that there is no longer any reason why electric furnaces should be as wasteful as many of them have been in the past.

The rule for determining the best cross-section is as follows: The current and the drop of temperature between the inside of the furnace and the outside ends of the electrodes are supposed to be given by the specifications of the furnace. The length of the electrode can be made anything one chooses, but some definite length must be fixed before the cross-section can be determined, as the cross-section depends on the length.

For this drop of temperature, find the corresponding value of s in the accompanying table for the material which is to be used. This number is the specific section for that drop of temperature; it is quite analogous to specific resistance, that is, to ohms per cubic inch or per mil-foot, etc., at a high temperature; it represents the section per ampere and per inch (or centimeter) length. Hence, the proper cross-section (in square inches or square centimeters) is equal to this specific section s multiplied by the current in amperes and the length (in inches or centimeters as the case may be). By repeating this very simple calculation for each of the several materials and for various lengths, if there should be any choice in them, the results will show what it is best to use and will enable the cost of the electrodes to be readily determined. The size thus obtained is the one which will not chill the furnace product by the abstraction of heat, and which corresponds approximately to the condition of least total loss of energy in the electrodes. This will be further explained below.

It is also often of interest to know what the total loss of energy in the electrode is. This is also an extremely simple calculation when the electrode is proportioned as above described. From the accompanying table find the value of e for the given material and temperature drop, and multiply it by the current; the result is the total loss in watts for one of the electrodes. This value of e is again a specific quantity, being the total loss (in watts) per ampere for each electrode. It applies correctly only to electrodes proportioned as above described.[1]

[1] When not so proportioned, see formulas in article on "Improving the Output and Efficiency of Existing Furnaces," Metal. & Chem. Eng., May 1910, p. 276.

Sometimes it is also of interest to find out how much current could be used in an existing furnace with given electrodes, because in any case, no matter how badly the electrodes have been proportioned, it is always possible to so change the current (generally by increasing it) that the existing proportions are correct; and as electrodes proportioned according to the older rules are often far too large, the capacity of such a furnace can, by increasing the current, generally be greatly increased besides diminishing the relative loss.

To determine this correct current, find the proper value of i in the accompanying table, multiply it by the existing section in square inches and divide it by the length in inches (or use centimeters and the corresponding value of i); the result is

TABLE OF ELECTRODE CONSTANTS.

Temp. drop		Section s		e	Current i	
C	Fahr.	Sq. Inch	Sq. Cm.	Volts	In. Units	Cm. Units
Copper						
800	1,472	.000014	.000036	0.18	70,300	27,700
1,000	1,832	.000014	.000035	0.22	71,800	28,300
1,200	2,192	.000014	.000035	0.26	72,800	28,700
1,400	2,552	.000014	.000035	0.30	73,400	28,900
1,600	2,912	.000013	.000034	0.34	73,900	29,100
1,800	3,272	.000013	.000034	0.38	74,300	29,300
2,000	3,632	.000013	.000034	0.42	74,600	29,400
Iron						
800	1,472	.000100	.00026	0.29	10,000	3,900
1,000	1,832	.000100	.00025	0.30	10,000	3,900
1,200	2,192	.000099	.00025	0.43	10,100	4,000
1,400	2,552	.000099	.00025	0.49	10,100	4,000
1,600	2,912	.000098	.00025	0.56	10,200	4,000
1,800	3,272	.000098	.00025	0.63	10,200	4,010
2,000	3,632	.000098	.00025	0.70	10,200	4,010
Graphite						
1,000	1,832	.00025	.00063	1.3	4,100	1,600
1,200	2,192	.00023	.00059	1.4	4,300	1,690
1,400	2,552	.00022	.00057	1.5	4,500	1,760
1,600	2,912	.00022	.00055	1.5	4,600	1,810
1,800	3,272	.00021	.00054	1.5	4,700	1,860
2,000	3,632	.00021	.00053	1.5	4,800	1,890
2,500	4,532	.00020	.00051	1.5	5,000	1,960
3,000	5,432	.00020	.00050	1.5	5,100	2,010
Carbon						
1,000	1,832	.00074	.00187	1.9	1,360	530
1,200	2,192	.00064	.00162	2.1	1,570	620
1,400	2,552	.00057	.00145	2.3	1,750	690
1,600	2,912	.00052	.00132	2.5	1,920	750
1,800	3,272	.00048	.00123	2.7	2,070	810
2,000	3,632	.00045	.00115	2.9	2,200	870
2,500	4,532	.00040	.00102	3.3	2,500	980
3,000	5,432	.00037	.00093	3.7	2,700	1,080

the current in amperes which corresponds to those proportions of the electrodes. This value of i is again a specific quantity, being the current per square inch section, for an inch length.

Examples.—Let the current be 1000 amp and the furnace temperature 2100 deg. C. (about 3800 deg. Fahr.), hence the drop of temperature is about 2000 deg. C.; let the electrodes be graphite and let the length be 10 in. Then from the table $s = 0.00021$ sq. in. Hence the section is $0.00021 \times 1000 \times 10 = 2.1$ sq. in., or about 1⅝ in. diameter. If the length were 15 in. the section would be 3.15 sq. in. Or, if it were carbon and 10 in. long it would be $0.00045 \times 1000 \times 10 = 4.5$ sq. in., hence more than twice as large.

The loss for the graphite electrode, e being 1.5, would be $1.5 \times 1000 = 1500$ watts per electrode, and would be the same whether the length is 10 in. or 15 in., provided the section is correctly proportioned. For carbon, $e = 2.9$, hence the loss would be 2.9 kw, or nearly twice as much.

Suppose the electrodes had been proportioned according to the older rule, namely, that the maximum current density is 50 amp per square inch for carbon, hence the section is $1000/50 = 20$ sq. in. What would be the best current for those electrodes? From the table the value of i is 2200 amp, hence $2200 \times 20 \div 10 = 4400$ amp. This, together with the fact that the relative loss would be greatly reduced by this correction of the proportions means that the available heat in the furnace could, by proper proportioning, be increased nearly five and one-half fold, showing how greatly we have been misled by the older current density rule. If the new current density is considered too high, it is merely necessary to increase the length and redetermine the section; the results as to power and efficiency will remain the same.

In all the above calculations the length is only that portion which may be considered to be the essential part of the electrode—that is, the part embedded in the walls—and which is necessary to carry the current from the outside to the inside; it, therefore, does not include the portions which project either into the inside or beyond the outside for feeding purposes, both of which portions have entirely different functions and the proportions of which are, therefore, based on entirely different considerations. The essential part may, however, without any great error include a portion of that embraced by the water-jacketed terminal and a portion of that which may project into the inside. That portion of any electrode which is in the open air outside of a furnace and is intended for feeding purposes in arc furnaces is, of course, a dead resistance, and the loss in it is a dead loss as it cannot be utilized to check the outflow of furnace heat, as is the case with the resistance loss of that part which is embedded in the walls; hence those exterior portions should be made as short as practicable, and wherever possible the terminal should be placed quite close to the furnace wall and the electrode fed through it.

There are many other general deductions from these investigations which may sometimes be of use in practice, among which may be mentioned the following: When it is found in a resistance furnace that the products around the ends of the electrodes are chilled—that is, when they are considerably cooler than toward the center—it means that the electrodes are too large in section, or too short, or the current too small. If, on the other hand, the electrode is found to get hotter within the walls than in the furnace it means that the electrodes are too small in section, or too long, or the current is too great.

With respect to the economy of both material and power loss, the materials have the following relative ranks: Copper, iron, graphite and carbon, hence whenever practicable metal electrodes would be better as they are smaller and more efficient. For annealing furnaces, for instance, it would be far better to use copper electrodes. Carbon would be the worst.[2]

The proper cross-sections for all materials and for the same length and current become smaller the higher the temperatures, and as this decrease seems to become less and less, it follows that at high temperatures the cross-section becomes less and less dependent on the temperatures,[3] which means that for the arc furnaces, in which the temperatures are higher, it is not necessary to know these temperatures accurately in order to calculate the sections, as they will be nearly the same for all the higher temperatures. For iron the section is practically the same for all temperatures.

This is not true, however, of the power loss for the same current, as this seems to increase roughly in proportion to the temperatures, although for graphite it seems to approach toward constancy.

For the same electrode, however, if the temperature is increased by increasing the current, the total loss is very nearly proportional to the temperature for all materials.[4] Hence, as far as loss in the electrodes is concerned, the temperature of a furnace should not be any higher than what is required for the desired thermal reactions.

This investigation, besides pointing out this new method of calculating electrodes, which is far simpler than the older ones, also shows that in some respects the older rules and ideas were actually wrong. Among the latter are the current-density rule which until a year ago was universally used; the rule to make the resistance as low as practicable; the belief that a high thermal conductivity is bad and necessarily chilled the furnace; the belief that the chilling action could not be prevented; some of the rules concerning the proper lengths, which were wrong even in their sign; the summation of the losses by conduction and by resistance; the belief that the two conductivities of a material were by themselves measures of the qualities

[2] For detailed data and comparisons see "The Proportioning of Electrodes for Furnaces," *Proceed.* Am. Inst. Elec. Eng., March, 1910, p. 285, abstracted briefly in this journal, April 7, 1910, p. 848. Also "Empirical Laws of Furnace Electrodes" to be published in the *Trans.* Am. Electrochem. Soc., Vol. 17. Also "Properties and Behavior of Furnace Electrodes," Metal. & Chem. Eng., March, 1910, p. 128.

[3] See first two references just cited, Figs. 10 and 11 of the first, and Fig 1 of the second.

[4] See Fig. 6 in the first of the references just cited.

of electrode materials; the belief that electrodes should be made large, when it actually saves power as well as material to make them small, etc.

The announcement of this more rational method of designing electrodes[5] gave rise to considerable discussion, chiefly by academicians, who, not having had the training of an engineer, laid great stress on mathematical minutia, which, though of interest to the mathematical physicist, are of too small importance for the practical engineer to concern himself with; nevertheless, strong and persistent efforts were made to misrepresent and discredit the results and to cloud the whole issue, thereby leaving the incorrect and unjust impression that this new method of designing electrodes is unreliable, although none of those attacking the method were able to show that the supposed error was large enough to warrant their attacks. It has since been shown,[6] however, that these supposed errors were not only small, but were actually non-existent when the complete method was used, which involved a method of determining the physical constants in such a form that they completely eliminated the much-discussed correction factors. Moreover, it has also since been shown that the same final results may be obtained by the entirely different and much simpler and more direct method described above, which completely eliminates those features which so greatly disturbed the mathematical minds of the academic critics; this new method reduces the calculation of the best proportions of electrodes and the losses in them to the same simplicity as the calculation of the resistance and loss of energy in a wire.

The complication in the design of an electrode lies in the fact that, being necessarily a good electric conductor, it was naturally also a good or fairly good heat conductor and therefore carried off heat from the furnace, whereby it chilled the furnace products around the hot ends of the electrodes; this not only wasted a lot of heat, but reduced the capacity of the furnace, and in some cases very greatly, by reducing the temperature of those parts located around the electrodes.

The total loss is made up of two parts: one, that due to the resistance, and the other that due to this loss of conducted heat, and the question is: what proportions will make this total loss the least?

It is evident, without any mathematics, that if the current in a given electrode is increased (or the cross-section for a given current diminished) the electrode will become hotter and hotter due to its electrical resistance. By thus increasing the resistance heat, a point will evidently be reached when the hot end will be heated by the current to the same temperature as that of the furnace, and under those circumstances it follows that no furnace heat will leave through the electrodes, because no heat will flow between two points which have the same temperature. Hence, under those conditions the furnace will have its full capacity because there will be no chilling around the electrodes and there will be no loss of furnace heat through the electrodes, which then act as a perfect heat insulator.

When the writer first announced this principle about a year ago it was ridiculed on the ground, it was thought, that it was absurd to intentionally increase the loss due to resistance, as our older rules taught us to make this loss as small as possible. It can readily be shown, however,[7] that the total loss is then the least, under ideally perfect conditions, and practically the least under the conditions encountered in practice.[8]

Hence the fundamental principle of electrode design is *to so proportion the cross-section and length that the current will heat the hot end to the furnace temperature.* The above-described method is based on this principle, as are also the tables of physical constants given above, which were recently determined by the writer.[9]

The writer desires to call especial attention to the fact that the above-described direct application of these constants to practice is entirely independent of any of the theoretical or analytical processes which led to the evolution of this method; it is a direct step from the observed constants to their application to other electrodes under similar conditions, involving no other assumptions than that these constants are specific properties—that is, that like specific resistance, specific heat, specific gravity, etc., they apply equally well to bodies of different sizes and shapes. While it is not claimed that this is rigidly exact because it would involve perfect heat insulation laterally, any deviation from mathematical exactness is probably well within the precision with which furnaces can be built and operated. The elimination of the correction factors due to temperature coefficients of the conductivities is, however, complete, as they are embraced in the constants as given.

As one of the advantages of proportioning electrodes in this way is the more complete utilization of the interior capacity of a furnace, attention is here called to the fact that an analysis of the question of heat losses through the furnace walls[10] shows the great importance of not wasting any space in the inside of a furnace if the power efficiency is of any importance.

[5] "Laws of Electrode Losses in Electric Furnaces," *Trans.* Amer. Electrochem. Soc., Vol. 16, 1909, p. 265. Reprinted in part in *Electrochem. & Metal. Industry*, October, 1909.

[6] "Modifications of Hering's Laws of Furnace Electrodes," A. E. Kennelly. *Proc.* Am. Inst. Elec. Eng., March, 1910, p. 267. See also discussion by H. C. Richards, in the writer's paper on Laws of Electrode Losses, cited above.

[7] See reference cited above on the laws of electrodes.

[8] "Chilling or Heating Action of Furnace Electrodes Versus Least Electrode Loss," *Metal. & Chem. Eng.*, April, 1910, p. 188.

[9] "Determinations of the Constants of Materials for Furnace Electrodes," to be published in the *Trans.* Am. Electrochem. Soc., Vol. 17, 1910.

[10] "Heat Conductance Through Walls of Furnaces," *Trans.* Amer. Electrochem. Soc., Vol. 14, 1908, p. 215.

Central Station

Management, Policies and Commercial Methods

EFFECT OF IRONS ON RESIDENCE RATES.

Mr. Alex Dow, of Detroit, in a recent discussion on rates at the N. E. L. A. convention, said that in the central-station companies with which he is connected flatirons add about 50 per cent to the gross income from residence customers. With low rates and good service he does not consider it necessary or advisable to spend much money in solicitation of residence business. The revenue from any one consumer will not justify such solicitation unless the solicitor has nothing else to do and temporarily goes after residence business on existing lines to fill in time. Residence business must depend for its success on handling large numbers of small consumers without much work. With the proper kind of low rates and good service the business will come, as is being demonstrated in Detroit, where residence consumers are coming on at the rate of 500 per month. The company can afford to see that irons once purchased are repaired and renewed in order to be sure they are kept in service and not put on the shelf.

CITY PUMPING CONTRACT AT HARVARD, ILL.

The Harvard Light & Power Company, of Harvard, Ill., has recently entered into contract with the city for pumping for the water-works system. The rate to be paid is 8 cents per 1000 gal. The lift is 165 ft. from deep wells to the water tower, of which 40 ft. is in the wells. The city furnishes the pumps and hydraulic appliances and the company furnishes the motor, labor and attendants. Each party to the contract is to maintain its own apparatus. The city water plant has been pumping 175,000 gal. to 200,000 gal. per day. The water rates are 16.5 cents to 40 cents per 1000 gal.

CLEVER CENTRAL-STATION ADVERTISING.

The Wenatchee Electric Company, Wenatchee, Wash., took advantage of the presence of a tuberculosis exhibit in the city under the auspices of the State Board of Health to set forth in the newspapers the merits of the vacuum cleaner. In large type is the query: "Have you seen the tuberculosis exhibit at the Commercial Club?" In smaller type, occupying only a fraction of the space available, is the following matter: "Dust is the greatest conveyor of disease germs, and dust is thoroughly and easily removed by the electric vacuum cleaner."

ELECTRIC LIGHTING AND INJURY TO SHADE TREES.

A New York court has decided that an electric light company may not cut or trim a tree in a city street unless it appears that this is reasonably necessary in lighting the streets. An action was brought against the Syracuse Lighting Company to recover damages for the mutilation of a tree standing in front of the plaintiff's premises. The plaintiff did not claim ownership of the tree, nor did the electric light company. In fact it did not appear who owned the tree. It was held that, although the plaintiff was not the owner, he had a right in the nature of an equitable easement to have the tree maintained. The company had no right to impair the usefulness or beauty of the tree, unless it appeared to be reasonably necessary, in order to properly light the streets. Whether the cutting of the tree was reasonably necessary was held to be a question for the jury to decide. A decision in favor of the company was reversed and sent back for a new trial.

COST OF A SMALL PRODUCER GAS PLANT.

The Shelburne Falls Electric Light & Power Company recently filed with the Massachusetts Gas & Electric Light Commission an inventory of its physical property, including the construction cost of a 90-kw producer gas-electric plant, which has been in operation for about a year. The cost of the latter is given in the above figures, excluding land, building and building foundations, which were not separated.

GAS PLANT.

1 Westinghouse gas producer with wet and dry scrubber	$3,000.00
1 " 3-cylinder gas engine, 75 hp	4,600.00
1 " " " " 40 "	3,400.00
1 small gasoline engine, 2½ hp	250.00
Freight and cartage	224.50
Foundations for engine and producer	225.00
Labor installing engines and producer	427.00
Helper " " " "	160.00
Piping engines and producer	350.00
	$12,636.50

ELECTRIC PLANT.

1–60 kw generator and exciter	$1,300.00
1–30 " " " "	900.00
Switchboard	900.00
Engineering and superintendence	1,000.00
1 Buffalo C & F blower	100.00
Coal elevator	125.00
Plumbing	150.00
4 pumps	135.00
3 air tanks	30.00
1 water tank, copper lined	60.00
	$4,700.00
	12,636.50
Total	$17,336.50
or, approximately, $193 per kw.	

PROPOSED COLORADO SPRINGS GASOLINE LIGHT ORDINANCE.

An ordinance is to be brought before the City Council of Colorado Springs to minimize the danger to property and life incident to gasoline lighting. The ordinance proposed provides among other things that all gasoline vapor gas-lighting machines, systems and lamps within 30 ft. of any building inside the city limits shall be constructed, installed and only permitted when approved by the city. The gasoline must be contained in reservoirs under ground, where used for lighting purposes. The city electrician shall inspect all gas-lighting machines and lamps; permits for installation must be secured from him and all applications shall be in printed form. No lighting system will be approved until the lamps are hung 3 ft. from all surrounding combustible material. Fines for anyone violating provisions of the proposed ordinance are placed at from $5 to $300 for each offence.

DISTRIBUTION SYSTEMS FOR ELECTRIC LIGHT AND POWER IN SMALL TOWNS.

Mr. H. A. Holdrege, general manager of the Omaha Electric Light & Power Company, gave a paper at the Nebraska Electrical Association convention, May 5, outlining his ideas as to good standard practice in distribution systems for small towns. He said that three-phase, three-wire, 2300-volt, 60-cycle distribution has become so nearly standard as to leave no room for choice. For street lighting with this system use is made of a constant-current transformer and series circuits. He recommended limiting such a constant-current circuit to 4000 volts maximum potential. In small towns one feeder will usually be sufficient if all of the load is in one direction from the station. If the load is in several directions, the feeders may be divided. In somewhat larger towns, one feeder for the business district and one for the residence district might be desirable. In still larger plants where motor loads can be obtained a separate motor circuit should be run. In the business section two or three transformers should be connected at different points to the same secondary network. In residence districts a single transformer on each secondary without the secondaries interconnected will usually prove best.

Line wires should not be smaller than No. 6. He would limit cross-arms to four pins, and would never put a primary and secondary line on the same cross-arm. All hardware, lag screws, bolts, etc., should be galvanized. The secondary distributing system should be grounded if possible to water pipes. In Omaha, since the water company does not permit grounding to water pipes, his company grounds to buried copper plates. Lightning arresters for 2300 volts should be placed one to each mile of circuit. He advocated fusing transformers heavily, as they will stand a short overload. In answer to a question as to the smallest transformer he would recommend installing, Mr. Holdrege said that 5 kw is the smallest size in Omaha. In small towns he thought that probably 1 kw would be the smallest advisable.

Mr. B. C. Adams, of Lincoln, said that he favored heavy transformer fuses, as lighting peak loads are usually short and the transformers can stand considerable overload during the peaks. Mr. E. A. Bullock, of Norfolk, thought that a 5-kw transformer is small enough for any town, and that usually the company does not see far enough ahead in the growth of the business and purchases transformers which are too small. He is now buying nothing smaller than 10 kw, and is pushing the older and smaller transformers into the outskirts. Mr. Adams, of Lincoln, said that several years ago his company had six blocks of secondary lines tied solidly together. This had since been cut up into sections, because of the liability of the blowing of one fuse causing all to blow and trouble in re-fusing transformers when such was the case. Mr. Glass said that sometimes the construction can be made much neater with a continuous secondary network than with individual transformers and a lot of secondary wires radiating from each transformer.

Mr. Holdrege said that his company in the underground district in the center of Omaha sometimes had as much as 600 kw in transformers connected to the same secondary network. In this case the secondaries of each transformer are fused, and the secondary mains are sectionalized with fuses between the sections

Mr. Adams thought that there was a place for transformers of less than 5 kw, as there are many places in the residence district where a 5-kw transformer is not needed and where its installation involves needless investment.

Mr. Harry Glass, of Pittsburgh, told of a plan in use in Pennsylvania of having different colored insulators for different voltage lines in order to protect the linemen by giving them knowledge of the circuits.

Mr. Holdrege expressed his strong disapproval of the scheme of having different colored insulators for different voltage lines. It is very beautiful in theory, but it is almost impossible to get the linemen when doing construction work to follow the rules (especially if they run out of insulators of one color), and if the rules are not followed as to color of insulators, it is a very dangerous thing because of the false sense of security it may inspire. He thinks the insulator color scheme simply invites trouble. The company would be liable if a lineman were injured because of a faulty designation of any line. Mr. Glass replied that one man was held responsible for the correct use of insulators in construction work, and the company referred to had experienced no trouble. In answer to a question, Mr. Holdrege said that his company overfuses its transformers 100 per cent. The 220-volt delta-connected motor circuits are grounded on one phase.

INVESTIGATION OF ENERGY SUPPLY FOR A GROUP OF MANUFACTURERS.

The energy supply problems of establishments containing a group of manufacturers under a single roof are often of general engineering interest, on account of the diversified conditions usually encountered and the frequent opportunities to introduce operating economies by rearrangement of the installation. In some cases economy can best be obtained by remodeling the installation, while in other instances the purchase of central-station energy offers the largest opportunity for efficient operation. The general method of conducting investigations of energy cost in buildings is instructive, regardless of the specific decision to retain isolated plant power or to install central-station service, if the analysis is made on the basis of actual tests and experienced judgment as to the proper values to assign for maintenance and fixed changes.

A representative investigation of this character was recently concluded in a building containing 19 tenants, manufacturing jewelry, working in silver, brass, enamel and electro-plating. The analysis of energy cost was made for the purpose of comparing the present system of motive power, heating and lighting with the cost of central-station service. In this particular case the central-station service proved to be more economical and the owners decided to install it. At present, energy from a steam engine is distributed over the basement and six floors by means of line shafts, belts, tight and loose pulleys, counter shafts and idlers. There are three speeds of line shafts, viz., north section, 180 r.p.m.; central section, 130 r.p.m.; and south section, 125 r.p.m. Two rooms are equipped with individual motors for auxiliary power, and a hydraulic elevator is driven by a steam pump in the basement. A mixture of soft coal and No. 3 buckwheat is drawn in by wagon loads daily, no reserve being kept on hand.

Water for boiler and drinking purposes is purchased from a local company. Water for other purposes is supplied by a belt-driven pump in a deep well. The pump has a cylinder diameter of 4 in. and a stroke of 12 in. The maximum well and pump capacity is 22.5 gal. per minute. The artesian well water is not fit for boiler purposes. A wagon load of ashes is removed daily. The steam-generating equipment consists of two 100-hp vertical Manning boilers supplying all the steam and hot water used in the building. One boiler is sufficient for ordinary load conditions and the other is kept in reserve for the winter peak load. A 12½-in. x 36-in. single-cylinder improved Greene engine supplies all the day energy of the establishment. This engine is about 25 years old and carries the summer load with 80 lb. steam pressure. During the heavy loads of the winter, however, the boiler is forced to 110 lb. steam pressure and the engine is just able to carry the load. Its rated speed is 110 r.p.m., and the actual running speed noted under medium load was 107 r.p.m. The engine exhaust is usually ample for heating the building, though at times of extreme cold, live steam is by-passed into the system. The steam-driven vacuum pump for the heating system has a 6-in. x 9-in. steam cylinder and a 10-in. x 9-in. vacuum cylinder. The elevator is supplied with hydraulic pressure by a steam-driven pump working in connection with a pressure and a surge tank. The steam cylinder of the pump is 14 in. x 10 in. in dimensions and the water cylinder is 8 in. x 10 in. in diameter and stroke. About half the tenants are using central-station service for lighting.

A number of years ago a motor was belted for driving the

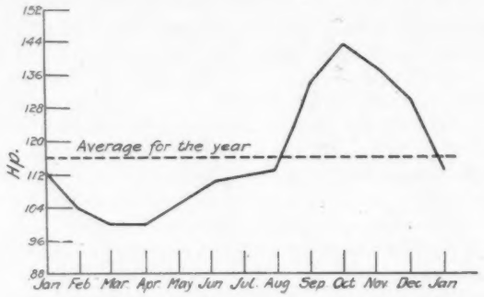


Fig. 1—Typical Year's Load for Jewelry Factory.

entire factory from one point. Since this method of driving is almost identical with that now in use with the steam engine, the motor was at that time carrying practically the same load that the steam engine would have carried had it been driving the factory. In 1902 tests showed that the motor was carrying a load of 49 hp. The figure is interesting in the light of the recent engine tests, which show the great increase in power demanded by the building. In order that the load indicated by tests could be compared to the average load for the entire year, a curve was plotted (Fig. 1) showing the average monthly

TABLE I.—ENGINE TESTS.

	Maximum	Minimum	Average
Jan. 20, 1910, P.M.	108 hp	95 hp	99 hp,
Jan. 21, 1910, A.M.	110 "	56 "	96.5 "
Jan. 21, 1910, P.M.	113 "	63 "	96 "

loads of a typical jewelry manufactory for each month of the year. This load curve was deduced from very complete tests made for a period of five years. From this curve it will be

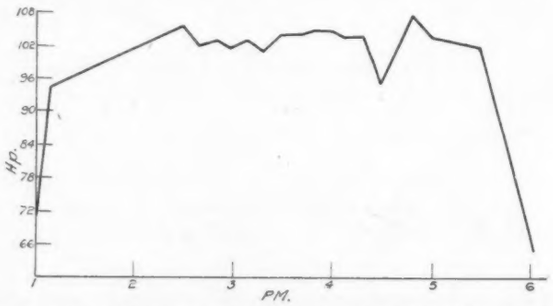


Fig. 2—Load Curve Thursday, P. M., Jan. 20, 1910. Average Load 99 H. P.

observed that the average load for the year is somewhat greater than the load for the latter part of January. This feature was borne in mind in all the estimates of the probable power required to drive the factory under consideration for an entire year.

To obtain the load characteristics under average working conditions careful indicator tests were made on the Greene engine every 10 minutes for a period of 1.5 days. The results of these tests are shown in Table I.

A typical curve and indicator cards are given in Figs. 2 and 3. In every five hours the load begins to decrease from 30 to 60 minutes previous to closing the shops. At the time of closing

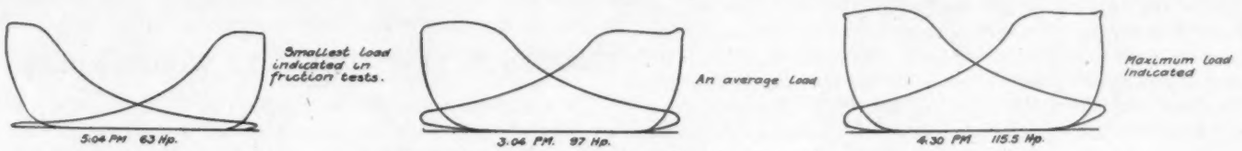


Fig. 3—Typical Indicator Cards, Jan. 21, 1910.

the load drops to the amount of friction that has to be carried when running overtime. The smallest amount of friction load after the factory had been shut down was 56 hp. Whenever it exceeded that amount it was due to fans, buffing shafts or machines being left on. The average of these day loads was 97.5 hp, and 100 hp was assumed as the average demand of the installation for the entire year.

TABLE II.—POWER REQUIRED BY MACHINES.

Load	Amps.	Volts	HP Net
Motor running free	2.5	500	1.67
A. Brass room and blower on, buff room off, grinding room blower on	9	500	4.33
B. "A" less grinding room blower	8.5	500	4.00
C. "B" less brass room blower	7	500	3.00
D. "C" plus grinding room blower and grinder	8.5	500	4.00
Average load working	10	500	5.00
Maximum load working	12	500	6.33
E. Brass room blower off, grinding room grinder and blower off, buff room on	12	500	6.33
F. "E" less shafting, twisted belt and 4 heads	8.75	500	4.17
G. Brass room idle and blower on; buff room shaft and blower off; grinding room blower off	8.5	500	4.00
H. Same as "G" except grinding room blower on	9	500	4.33
I. Working all three rooms	18	500	10.33
J. "I" plus roll in average use	20	500	12
maximum use	25	500	15
K. Buff and grinding rooms active, brass friction only	15.5	500	8.67

TABLE III.—POWER REQUIRED IN DIFFERENT DEPARTMENTS.

Load	HP	
Grinding room drive friction	0.34	
" " blower	0.67	idle
" " wheel	0.66	
" " work	0.33	
Total	2.00	
Buff room drive friction	0.67	
" " No. 2 blower, heads, etc	3.33	
" " miscellaneous during labor	0.66	
Total	4.66	
Brass room drive friction	2.00	
" " No. 3 blower	1.00	
" " work	0.67	
Total	3.67	
Brass room roll intermittent	1.66	

On Jan. 29 a test was made of the 500-volt, direct-current, 20-hp motor driving the machinery in three of the building's rooms. The result of the test was as follows:

The grinding-room has a Champion blower and 15-in. x 2-in. grinder. The buff room has one No. 2 Sturtevant blower, and two shafts of 4 buffheads each. The brass room has one No. 3 Sturtevant blower, 5-in. x 9-in. roll, three spinning lathes, one lathe, 7-in. metal saw, above motor and countershaft.

TABLE IV.—POWER REQUIRED IN COLOR ROOM.

Load	HP
Color room and buffers running light	1.00
Sand blast and blower	0.67
Plating generator, etc	1.00
Buffer work	0.17

From the electric test data in Table II the divisions of loads in Table III were deduced.

In a color-room of the building is installed a 5-hp motor of the 500-volt, direct-current type. The results of a test on this motor with different machines connected are given in Table IV.

COST OF PRESENT SYSTEM OF DRIVING, HEATING AND LIGHTING.

The plant was appraised at a value of $1,540 for the engine and $1,880 for the boiler. An interest allowance of 5 per cent was made. The same percentage was taken for depreciation, and also for repairs and renewals. Taxes and insurance were allowed ½ per cent each. The cost of coal for all purposes was $3,130.23 in 1909, which amounted to 737 tons at $4.25 per ton. The cost of water purchased came to $935.64, of which $300 worth was fed to the boilers. The plant requires the services of one engineer, whose wages, including overtime, are about $1,040. The distribution of energy from the engine by means of shafting, belting, etc., requires a large part of the attention of a millwright and his assistant. On account of all shafting being interbelted, whenever there is any trouble with the transmission in the room of any tenant, or at any other part, it is necessary to shut down the engine to rectify the trouble. On that account the strictest watch is kept of the installation. A charge of $1,200 per year is made against inspection and maintenance for delivering energy to the users. Handling of ashes, purchasing oil, waste and other items were figured at 5 per cent per year. The summarized cost of operating the steam plant is given in Table V.

TABLE V.—COST OF OPERATION BY STEAM.

Interest, 5 per cent	$171.00
Depreciation, 5 per cent	171.00
Repairs and renewals, 5 per cent	171.00
Taxes, ½ per cent	17.10
Insurance, ½ per cent	17.10
Coal	3,130.23
Water	300.00
Labor	2,240.00
Sundries, 5 per cent	171.00
Electric power	203.50
Electric light	894.70
Total	$7,486.63

or, $74.87 per hp-year, on the basis of 100 hp average load.

ELECTRIC DRIVING.

Plans for the installation of electric driving on central-station service covered 48 motors aggregating 150.75 hp, the individual sizes varying from 0.25 hp to 7.5 hp. It was estimated that the use of these motors would save 420 hp-hours daily, with the introduction of many economies at the factory. The engine load for 10 hours per day was figured at 100 hp, and the elevator pump consumed 15 hp-hours per day, so that the net energy required to drive with motors becomes 1015-420 hp-hours, or 595 hp-hours per day, the average motor load being 59.5 hp. A saving in energy was also figured by the use of exhaust fans in place of blowers for ventilation. The owners of the building would use 57 hp in 12 motors, and the tenants 93.25 hp in 36 motors. Local practice is to provide but one motor per room for tenants, who would then have 80 hp in 20 motors. The effect of this would be to reduce the electrical investment 20 per cent, increase the tenants' load, earn a lower energy rate, increase profit from tenants, and increase the total profits of the building. The initial cost of the installation of 150.75 hp in motors would be $3,877.50, or $25.72 per horse-power. The average cost of wiring for the motors was estimated at $4 per horse-power, or $603 for the installation. Millwright work would have to be done amounting to $2 per horse-power, or $301.50 for the entire job. Either the engineer or the millwright will have ample time to inspect and maintain the motors.

The electrical input for the year would be, with the motor drive, 136,600 kw-hours, the net cost being $4,071.60. There could be resold to tenants 96,200 kw-hours at a price of $4,329.

The net cost of electric lighting to the owners of the building would be $457.98 per year. With the engine disconnected all coal used would be for heating service. For buildings of approximately the same contents, and used for the same purposes as the one in question, there is required for heating, live steam, and hot water, 1 lb. of coal per year per cubic foot of factory contents. The building under discussion has a heating contents of 900,000 cu. ft., which would, on the foregoing basis, require the burning of 450 tons of coal at $4.25 per ton, or $1,912.50 per year. The present cost of water for steam purposes is estimated at $300 per year. During one-half of the year, the exhaust is used for heating the building and during the other half it is thrown into the air. This latter proportion will be saved by the use of the motor drive. Hence, the future water costs per year will be $150 for steam generation. The summarized cost of electric operation are shown in Table VI.

TABLE VI.—COST OF OPERATION BY ELECTRICITY.

Interest, 5 per cent.	$331.10
Depreciation, 5 per cent.	331.00
Repairs and renewals: boilers, $50; motors, $75.	125.00
Taxes and insurance, 1 per cent total.	66.62
Coal.	1,912.50
Water.	150.00
Labor.	1,000.00
Sundries: boilers, $60; motors, $15.	75.00
Electric power.	4,071.60
Electric lighting.	457.98
Total.	$8,520.90
Less re-sale of power to tenants.	4,329.00
Net cost.	$4,191.90

or, $27.94 per hp-year.

COMPARISON OF PRESENT WITH CENTRAL-STATION SERVICE.

The cost of energy, heat and light per year as at present produced is $7,486.63 against $4,191.90 with the proposed installation of motors and central-station service. This means a yearly profit of $3,294.73. When energy is sold separately floor space can be sold at a uniform rate per square foot. By getting all the tenants to use electric lamps the total profit will reach $3,600. By supplying tenants with 20 instead of 36 motors, the total profit would approach $3,900, and the cost of motors, wiring, etc., would be reduced to about $4,000. Overtime running of the engine for the owners now encourages all tenants to make free use of energy. With each tenant supplied through his own motor, overtime running would mean increased energy profits to the owners of the building. The load will increase rapidly in the future. If in eight years the load has risen from 49 hp to 100 hp, one may expect an addition of 6 hp or 7 hp yearly. Meanwhile tenants are paying no more for their greater demands on energy, and the engine is already loaded to the maximum during the busy season. Local trouble at any point on the six floors and basement necessitates the immediate stopping of the engine and the shutting down of the factory. Mischievous employees have been known to ring the emergency signal in order to have a period of leisure, which always ensues while the engineer goes over every floor to make sure that no damage will be done by starting up the engine. With individual motors no such trouble can occur. Upon the basis of this investigation a decision has been reached to install central-station service.

Wiring and Illumination

WIRING FOR MINES.

In replacing numerous steam plants by electric equipment throughout the Boulder mining district, the Central Colorado Power Company, in consultation with the Rocky Mountain Fire Underwriters' Association, has standardized the wiring for the mines. Use will be made of non-combustible transformer houses drained away from the plants and situated 50 ft. distant from other buildings with disconnecting switches outside the transformer building and with all secondaries for motors or lamps up to 500 volts grounded. The motor frames will also be grounded. All fuses are to be placed in steel cabinets. The 100,000-volt transmission e.m.f. is reduced to 13,000 volts for general distribution over the district. Most of the mine equipment is at 440 volts with either 110 volts or 220 volts taken off one phase for lighting. A few 2300-volt motor installations are also planned.

CHANGES IN NEW YORK CITY WIRING RULES.

The Commissioner of Water Supply, Gas and Electricity of the City of New York has announced the withdrawal of the interior wiring rules of the city comprised in Classes D, E and F and the substitution therefor of the wiring rules of the National Electrical Code, edition of 1909, comprised in Classes D and E with such modifications as are rendered necessary by local conditions. These are as follows: The fine-print note relative to the neutral of a three-wire system contained in Rule 50-B-e is omitted as well as the fourth fine-print note under Rule 54-a regarding the 6-in. spacing in front of fuses. Wood or approved composition in cut-out cabinets as provided for in Rules 54-b, c, d and e is not permitted in New York City. The following has been substituted for Rule 55-a:

"Owing to the interchangeability of carbon and metallic-filament lamp bases, sockets must be rated, for installation purposes, at not less than 55 watts each, except for sign and outline lighting.

"Sockets of all kinds, including wall receptacles, must be constructed in accordance with the following specifications: (a) Capacity. The standard key socket must be suitable for use on any voltage not exceeding 250 and with any device requiring not more than 250 watts. The standard keyless socket must be suitable for use on any voltage not exceeding 250 and with any device requiring not more than 500 watts. The rated capacity in amperes is 2.5 for the key socket and 5 for the keyless. For larger capacities or higher voltages sockets of special and approved design must be employed."

Rule 55-q and the fine-print note, relating to inlet bushings, have been deleted and the following rule substituted: "When the socket is not attached to a fixture, the inlet must be so constructed that it will have a perfectly smooth hole at least 9/32 in. in diameter, or the inlet must be protected by a strong insulating bushing at least 9/32 in. in diameter and the upper portion of this bushing must present a thoroughly smooth opening which will protect the cord from any cutting or wearing action."

The fine-print note to Rule 60-c relating to terminal clamps for rheostats is also omitted from the New York rules, as well as the fine-print note of Rule 64-a relating to the separation of signaling and electric lamp circuits.

The first paragraph of Rule 64-1-3 is amended to read: "If the piping system is metered, the ground connection must be made between the meter and the street mains unless an approved jumper is employed to carry the grounding current around the meter."

Rule 65-A-a has inserted after the word "constructed" in the second line the words "so far as practicable." The first sentence of Rule 65-A-c has been changed to read: "The top reel must be encased in a steel box or magazine with an opening of approved construction at the bottom, so arranged as not to permit entrance of flame to the magazine"; and the first two sentences of Rule 65-A-d are omitted and the following directions substituted: "The bottom reel must be encased in a steel box or magazine with an opening of approved construction at the top, so arranged as not to permit entrance of flame to the magazine." To this is added a new paragraph, which reads: "The front side of each magazine must consist of a door hinged to swing horizontally and provided with a substantial latch."

The present Rule 65-A-f has been omitted and the following substituted: "An automatic shutter, permanently attached to

the gate frame, must be provided, and must be so constructed as to shield the film from the beam of light whenever the film is not running at operating speed." In Rule 65-A-h the parenthetical clause is replaced by the sentence: "Departure from this rule will be authorized only under special permission in writing, given in advance."

The following additional rules have been promulgated:

Rule 64-A.—Aerial Conductors.

(a) Aerial conductors to be permanently and effectively grounded at all times *when station is not in operation* by a conductor not smaller than No. 4 B. & S. gage copper wire, run in as direct line as possible to water pipe at a point on the street side of all connections to said water pipe within the premises, or to some other equally satisfactory earth connection.

(b) Aerial conductors when grounded as above specified must be effectually cut off from all apparatus within the building.

(c) Or the aerial to be permanently connected *at all times* to earth in the manner specified above, through a short-gap lightning arrester; said arrester to have a gap of not over 0.015 in. between brass or copper plates not less than 2½ in. in length parallel to the gap and 1½ in. the other way, with a thickness of not less than ⅛ in., mounted upon non-combustible, non-absorptive insulating material of such dimensions as to give ample strength. Other approved arresters of equally low resistance and equally substantial construction may be used.

(d) In cases where the aerial is grounded as specified in paragraph "a," the switch employed to join the aerial to the ground connection shall not be smaller than a standard 100-amp jack-knife switch.

Rule 31-C.—Garages.

(a) Rigid iron conduit system must be employed.

(b) Cut-outs and switches must be enclosed in metal boxes placed at least 5 ft. above the floor level.

(c) Switchboards and charging panels must be located in a room or enclosure provided for the purpose.

(d) For portable lamps, flexible cable designed for rough usage must be employed, this cord carrying the male end of a 10-amp pin-plug connector, the female end of which is hung from a cable of the same type securely attached to the cover of the outlet box and of such length that the connector will hang freely at least 5 ft. clear of the floor. For all portable lamps, keyless molded-mica sockets, equipped with handle, hook and guard must be employed.

(e) For charging theater stage cable must be employed, this cable carrying the female end of a 50-amp pin-plug conenctor, the male end of which is hung from a cable of the same type securely attached to the cover of the outlet box and of such length that the connector will hang freely at least 5 ft. clear of the floor, the male end of the connector being protected against accidental contact by a shield or petticoat.

(f) Motors must be of the enclosed type and located not less than 5 ft. above floor, or must be enclosed in an approved fireproof room, shut off from the main building.

INCANDESCENT LAMPS AS STANDARDS OF LUMINOUS INTENSITY.

In a paper by Dr. C. H. Sharp and Mr. P. S. Millar presented before the New York Section of the Illuminating Engineering Society, on June 9, much information was given concerning the preparation, rating, use and reliability of incandescent lamps as photometric standards. For this purpose use is made of well-selected lamps that have been in service for such a length of time that the change in candle-power at constant voltage throughout a considerable length of time is inappreciable.

In regard to the seasoning of the lamps, the authors stated that in any given lamp, when the vacuum, the character of the surface of the filament and the transparency of the bulb are unaltered, the candle-power depends directly upon the watts expended in it. During the early life of the lamp, the watts expended in the lamp at constant volts change on account of a decrease in the resistance of the filament. When the filament has become stable, that is, when its resistance no longer decreases, the candle-power at constant volts no longer decreases. Now, the measurement of electrical resistance is the most precise, as well as the most convenient measurement which can be made. The method, therefore, has been adopted to measure the change in resistance of the filament at full voltage rather than the change in candle-power. The total change in resistance of a lamp in the period between its initial and peak candle-power is, roughly speaking, 0.5 per cent. To obtain a satisfactory determination of the exact point at which the seasoning process should be interrupted, the change in electrical resistance should be measured to something like 1 per cent or 2 per cent. It is necessary, therefore, that the electrical resistance should be measured accurately to one part in from 10,000 to 20,000. There are two available methods for measuring this resistance change. One is to measure the voltage and current. When the current ceases to change at constant voltage, the seasoning is ended. It is, however, a matter of some difficulty to measure the current through a lamp to one part in 10,000.

For measuring the resistance use is made of the Wheatstone bridge method which is easily capable of yielding results to the required precision, and which does not require an absolutely steady applied voltage. In using this method the lamp is connected in series with a manganin resistor, the resistance of which is equal approximately to that of the lamp when hot, and comparisons are made by means of a sensitive galvanometer. The useful life of an incandescent lamp standard is greatly extended when it is used at constant watts rather than constant volts.

In most commercial photometric work carbon-filament lamps of the ordinary oval anchored type, standardized rotating, form acceptable standards. For work of higher precision and for stationary standards in general, use is made of a special type of lamp consisting of two hairpin loops, one within the other, and lying in the same plane. The idea of this form of construction is to render it possible to determine the distance between the photometric center of the lamp and the photometer screen with the highest degree of precision. In the oval anchored type the different parts of the filament lie at different distances from the photometer screen; hence this distance cannot be determined with high accuracy. The filaments of the parallel filament type of lamp, lying as they do in the same plane at right angles to the axis of the photometer bar, enable the operator to ascertain this distance very exactly. Moreover, in this style of lamp the variation of the candle-power involved in a false adjustment of the lamp whereby it is not placed with its filaments exactly at right angles to the bar is very small, and the consequences of a mistake of this kind are minimized.

Ordinarily in the interests of long life, carbon-filament lamps are standardized operating at about 4 watts per candle. This high specific consumption involves the disadvantage that the light of the lamp is somewhat redder in hue than that of most of the lamps which are to be compared with it, though this disadvantage is not a very serious one until metal-filament lamps are reached. The comparison of a tungsten lamp at 1.25 watts per candle with a carbon lamp at 4 watts per candle involves very great uncertainties on account of color difference. On this account there has been established a set of tungsten standards, the candle-power of which is known in terms of the carbon standards. The color difference difficulty, having been met once for all, is eliminated in future work with tungsten lamps by the use of tungsten standards.

A great deal of attention has been given recently to the question of standardizing tungsten lamps, since this type of lamp, being very little subject to change in candle-power, would seem to make an ideal standard for the photometering of not only tungsten lamps, but also carbon lamps as well. In the latter case the tungsten standards would be standardized at a sufficiently reduced voltage to bring their color to the right quality. It has been found that the ordinary commercial type of tung-

sten lamp does not admit of very accurate standardization. The difficulty seems to be that a variable cooling is introduced by the contacts between the filament and the anchoring wires. To meet this difficulty there has been developed a type of parallel-filament tungsten lamp in which the anchor wires are dispensed with and all variable contacts are removed. This type of lamp is available only in low voltages, but from all indications furnishes a reliable standard. Another type of tungsten lamp standard has been developed, in which the filaments are in the form of straight pieces welded to wires at both the top and the bottom. This plan obviates the variable contacts and enables the construction of lamps for the range of e.m.f. between 100 volts and 130 volts.

In precision standards an error of not exceeding 0.1 per cent is obtainable. In commercial standards the error is kept within 0.25 per cent. The latter degree of accuracy, being greater than is obtained in much commercial photometric work, is sufficient in many cases.

DISCUSSION.

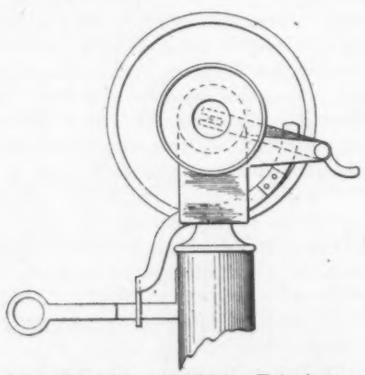
In discussing the paper Dr. Rosa remarked that the methods formerly used for ascertaining when lamps submitted to the Bureau of Standards had not been fully seasoned required observation of the performance of the lamps over a considerable period of time in order to detect any change in the light given by the filaments. At the present time use is made of measuring instruments at least 10 times as sensitive as formerly, and an observer can ascertain within 10 minutes if the lamps are not properly seasoned by noting some change in the resistance of the filament during that period.

An idea of the constancy and reliability of incandescent lamp filaments as primary reference photometric standards can be gained from the fact that accurate estimates show that if well-standardized properly seasoned carbon-filament lamps were used as reference standards regularly for 100 years the change in light given at certain wattage at the end of that time would be only a few hundredths of 1 cp.

NEW TELEPHONE PATENTS.

NEW APPARATUS.

A departure from the accepted standard desk set is described in a patent granted to Mr. J. E. Rogers, of Danbury, Conn. A base somewhat like that of the usual stand carries a similar stem. This latter is, however, hinged so that it may assume any convenient angle. The transmitter is swung in a pronged support, which extends at right angles to the stem. Use is made of two watch-case receivers carried upon the legs of a U-shaped prong. This prong rises from the stem piece, the center lines corresponding. The receivers are normally nearer each other than the width of the head of the average



Allen Sterilizing Shield for Telephones.

user. They may be thrown apart by a thumb lever extending from the stem piece. To use the instrument the thumb button is depressed and the stem swung down until the receivers are opposite the ears. The thumb lever is released, thereby allowing the receivers to meet the ears. In this position the stem should be below the chin, the transmitter supporting prong rising from the stem and supporting the transmitter mouthpiece near the lips. Incidental to the throwing out of the receivers the thumb lever has operated the switch mechanism, which will only return to normal with the release of the receivers. A latch is provided for holding the switch if the line is to be held when leaving the instrument.

ANTISEPTIC MOUTHPIECES.

Mr. F. M. Allen, of Chicago, is the inventor of the antiseptic device illustrated herewith. The apparatus is mounted by insertion between the transmitter and its mouthpiece. An antiseptic container drops from the mounting piece, within which is placed a padded disk. When the hook lever is down the disk is thrown up, thus closing the sound passage, and fumes from the pads invade the transmitter and mouthpiece. The hook when rising withdraws the disk, but a lever is provided to restore it in case it is desired to close the passage to sound during a conversation.

A very simple idea for an antiseptic mouthpiece has been brought forward by Messrs. W. M. English and H. M. Lichtenstein, of San Francisco, joint patentees. The walls of the mouthpiece are bulged out near the base of the mouthpiece to form an internal groove. This ring is circular in section, save that it is intersected by the bore of the mouthpiece. A ring of round section of absorbent packing may be forced into the cavity and will be held in place, with its inner surface projecting into the mouthpiece. This packing may be wet with antiseptic solution, the fumes of which will pervade the mouthpiece.

ATTACHMENT FOR PARTY LINES.

Mr. A. G. Howard, of Holdredge, Neb., has patented a device for regulating the service on party lines. It consists of two elements, first a detector for eavesdroppers; and second, a call timer. The first idea is embodied in a system of musical tones put upon the line by the lifting of any switchboard. These are coded for the different stations and are caused by reeds or similar apparatus. The second feature lies in a time indicator which is operated through a spring which must be wound incidental to the initiation of a call.

SIGNALLING APPARATUS.

Mr. O. T. Lademann, of Milwaukee, has invented a system of signalling for telephone stations of a composite telephone and telegraph line. The signal is primarily controlled through a high-frequency relay, the operating current for which can be successfully transmitted past the telegraph isolating coils at the various stations. At the local station a closed-circuit battery of few cells is connected to a differential delay one coil of which is in circuit with the contacts of the high-frequency relay. When these latter contacts are open the balance is destroyed and the differential relay operates to close a circuit containing the local signal bell and an ordinary open-circuit battery. With this arrangement powerful and expensive batteries are required.

STEP BY STEP SELECTIVE SYSTEM.

Mr. C. E. Bradburn, of Delmer, Ontario, has obtained three patents relating to a step-by-step selective system. The system as finally developed is suitable for train dispatching, permitting all stations to be simultaneously rung from the home station, which can also listen on the lines at all times. All stations can selectively call and signal any other, to the exclusion of the rest, and in case of emergency any locked-out station may put a signal on the line to indicate its desire to communicate. Means are also provided for adjusting a line which is out of step. Two dials with pointers are provided at each station. One is a sending dial and one a receiving dial. The first is moved manually at any station and the other pointers follow along to connect the desired station to the main line and to exclude all others. With the moving of one sending dial from normal, all others on the line become locked.

IMPROVEMENT FOR SEMI-AUTOMATIC SYSTEMS.

In all systems where party lines are used, some one must recognize when calls are made from one station to another on the same line, as in such cases the handling of the call is special. In some systems the subscriber must note the special

nature of his call, in others this duty devolves upon the operator, while in still others special signals are arranged to call attention to the nature of the call.

It is with the application of such a signal system to semi-automatic system, with which the patent granted to D. S. Hulfish and assigned to McMeen and Miller, is concerned. In this system incoming calls are automatically displayed to the any idle operator and therefore, as the operator has no clew to the calling party's number, she must have some other means of detecting the call, as it will be understood that the called line will always test busy to her. Mr. Hulfish arranges the circuits so that if the called and calling line of any desired connection be one and the same, a special signal will be apparent to the particular operator involved in the connection, which signal will overlie and countermand the busy test. All other operators testing will get the regular busy test.

LETTERS TO THE EDITOR.

An Ayrton Memorial.

To the Editor of Electrical World:

SIR:—There has just been issued a special number of *The Central,* the organ of the alumni of the Central Technical College of London, in memory of the late Prof. W. E. Ayrton, who died in November, 1908.

Professor Ayrton was one of the most active, if not the most active, advocate in the engineering field of the modern educational theory that the main value of a college training is the acquisition of accurate and economical modes of thought and action. In pursuance of this theory, Professor Ayrton originated a course of training for electrical engineers which reproduced in a condensed and rationalized form the researches which led to the discovery of the various principles upon which electrical engineering is based. The students were required to make these discoveries anew under the guidance of their instructors, and report upon their discoveries as if they were original investigators. In this way the fundamental facts and principles were instilled into the students' minds, so that they were not only understood but remembered. This method of study occupied the greater part of two years, the students being encouraged to undertake original investigations during the third year. The lecture courses were based upon the laboratory work and covered the theoretical conceptions which connect the isolated results of experiment, and also the practical applications of both theory and experiment.

Professor Ayrton's lectures were a fund of inexhaustible pleasure and inspiration to his students, both on account of their geniality and their enthusiasm. In his very first lecture to the class of which I was a member he said: "There is one thing in which you would do well to emulate the Americans, and that is their willingness to learn. An Englishman says 'my father did so and so; that is good enough for me'; an American says 'my father did so and so; that was good enough for him, but I can do better.'" Needless to add, being the only American present, the boys took it out of *me,* afterwards! On other occasions Professor Ayrton made equally complimentary references to America. One day a student spoke to him of some new apparatus, which measured hundreds of amperes, in tones which betrayed wonder at the capacity of the apparatus. The professor replied: "Hundreds of amperes! Hundreds! That's nothing. In America they measure amperes in thousands; *thousands,* mind you!" There was a rising inflexion in his voice as he uttered the word "thousands," which betrayed his enthusiastic admiration of the big scale of American enterprises.

To quote from the memorial issue of *The Central:* "Originality was manifested in nearly everything he did and said, and the wealth of incident and analogy with which his discourse was punctuated will remain firmly impressed on the minds of all who knew him." The memorial issue tells of Professor Ayrton's original researches, inventions, publications and of the distinguished positions which he held. It says, however, that: "If you would gage the full effect of Professor Ayrton's work, you must not look to the record of the distinguished positions he has held, to the list of his inventions nor to the tale of his publications; you must not look even to the positions which are held by those who have been his students; you must look rather to the methods in every electrical factory or undertaking in which his students have played a part, and there you will find that in a greater or lesser degree, according as the instrument was more or less worthy, his teaching has had its influence, and that some part of the success and prosperity is due to him."

Mrs. Ayrton, noted for her investigations of the electric arc, assisted him in much of his work and in recent years they both lent their powerful mentalities to the cause of "Women's Rights" in England. This was in consonance with his usual point of view that minorities are usually more correct than majorities, a conception which, he said, was indelibly impressed upon his mind by an incident of his youth. He was skating on a lake with his father when the ice began to give way. People rushed toward the sides with the object of getting to land, but the father said to his son: "Don't follow the crowd, come away from it," and both hastened to the middle of the lake, where the ice was sound; here they were perfectly safe, while the weight of the crowd caused the ice to give way near the edges, with the result that 40 persons perished. The professor used this story to impress upon his students the importance of critically examining the statements of even recognized authorities and the danger of "following the crowd."

The editors and contributors to the memorial issue of *The Central* are to be congratulated on their work, although it is a pity that it did not appear sooner.

New York. WM. A. DEL MAR.

The Induction Generator.

To the Editor of Electrical World:

SIR:—In answer to a correspondent, a technical periodical recently said that the addition of an induction motor driven above its synchronous speed to a circuit carrying an inductive load will increase the power factor, because its leading current will counterbalance the lagging current of the load. This incorrect statement illustrates the uncertainty with which most electricians view the induction motor when operated outside of the range from a slip of zero (synchronous speed) to the slip of one (standstill). The following diagrams may help to clear up the matter.

In a circuit containing a synchronous alternator and an induction motor, the synchronous machine impresses an alternating

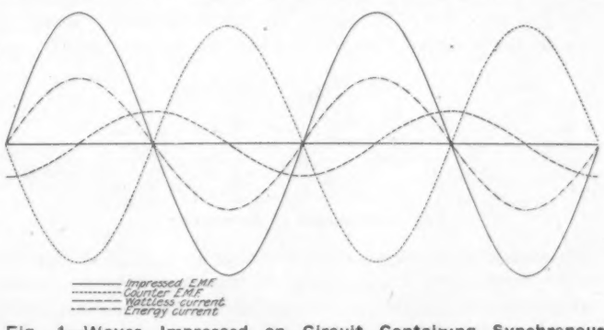


Fig. 1—Waves Impressed on Circuit Containing Synchronous Alternator and Induction Motor.

e.m.f. on the system, one phase of which may be represented by the accompanying full line sine curve. The induction motor produces a counter e.m.f. which is less than the impressed e.m.f. and opposite in phase to it. This may be represented by the dotted sine curve. The counter e.m.f., which is proportional to the rate of change of the flux, is 90 deg. in phase behind it. The flux is, of course, in phase with the magnetizing current, so that the counter e.m.f. is 90 deg. behind the magnetizing current. The impressed e.m.f. being 180 deg. ahead of the

counter e.m.f., therefore, is 90 deg. ahead of the magnetizing current, which tests show to be true. This may be shown by the sine curve of dashes. The power component of the current (dot and dash line) sent out by the synchronous alternator is, of course, in phase with the impressed e.m.f., so that

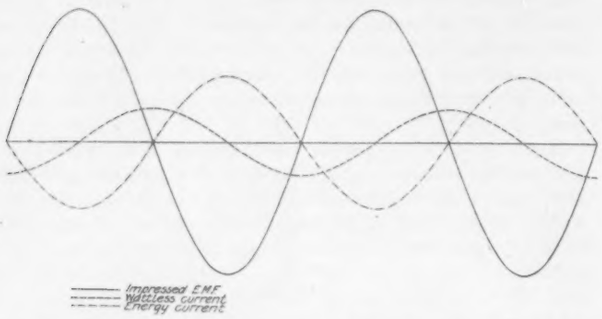


Fig. 2—Curves of Impressed e.m.f. Magnetizing and Energy Components of Current.

the total generator current, which is the sum of the two components, lags behind the voltage, which also is well known. These conditions represent the supply of energy from synchronous generator to induction motor.

When, however, the induction motor is accelerated above its synchronous speed, the rotor conductors travel faster than the revolving magnetic field. Below synchronism the magnetic field travels faster than the rotor conductors. The direction of cutting the field by the rotor conductors is thus reversed, which reverses the phase of the voltage induced in the rotor. This means that the rotor current and rotor torque change sign. The magnetizing current is not affected, however, as this depends only on the synchronous machine. Due to the transformer action of an induction motor, the transformed rotor current in the stator combines with the magnetizing current to form the line current. Fig. 2 shows the impressed e.m.f., magnetizing and energy components of the current, for operation above synchronism. It is perfectly correct that the wattless component of the current leads the energy component, but the wattless component does not lead the voltage as it should, in order to neutralize the lagging current of an inductive load. Instead of raising the power factor of the generator, it will have the opposite effect, because the magnetizing current will be increased while the energy current is decreased. If the induction machine is of greater capacity than the synchronous alternator, they interchange functions, the synchronous machine becoming a motor, as is shown by the opposition in phase of the voltage and energy current. This fact is taken advantage of in testing induction motors under load by the "pumping back" method.

Some oscillographs published on pages 464 and 465 of the *Electrical World* for Feb. 24, 1910, are of interest in this connection. The one at the top of page 465 shows one cycle that is longer than the others. It is the opinion of the writer that this is due to the shifting of the relative angular positions of the field magnets and the core flux of the synchronous machine when it changes from generator to motor.

Schenectady, N. Y. Selby Haar.

Digest of Current Electrical Literature

ABSTRACTS OF THE IMPORTANT ARTICLES APPEARING IN THE ELECTRICAL PERIODICAL PRESS OF THE WORLD

Generators, Motors and Transformers.

Commutation Phenomena in Direct-Current Machines.—J. D. Coales and T. F. Wall.—The authors refer to the paper of Worrall, recently noticed in the Digest, describing a method of examining commutation phenomena, in which the pulsations of flux due to commutation are recorded by means of search coils suitably arranged on the pole shoes. The e.m.fs. induced in the search coils are proportional to the rate of change of the flux. Since, however, the flux pulsations occur in the axis of the main field, corresponding e.m.fs. will be induced between the main brushes by reason of the rotation of the armature in the pulsation flux. By means of the arrangement shown in Fig. 1, the present authors have been able to ascertain the flux

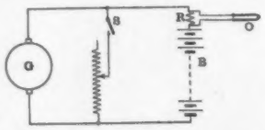


Fig. 1—Diagram of Arrangement.

pulsations due to commutation, and also the flux pulsations due to the armature teeth, without in any way disturbing the normal operation of the machine. The special feature of the method is that the e.m.fs. induced between the main brushes by the flux pulsations are directly proportional at any instant to the magnitude of the pulsating flux, and not to its rate of change. A continuous-current generator is shown at *G*, and a battery *B* giving an e.m.f. equal to the generator terminal pressure is arranged in opposition. Some convenient load is connected across the terminals of the machine and battery. The load can be adjusted and also, by means of switch *S*, entirely disconnected as required. A small non-inductive resistor *R* connected in the battery circuit forms a shunt for the oscillograph circuit *O*. The current due to any pulsating e.m.f. which may occur superposed on the main terminal voltage circulates through the battery and machine, and this is the only current through the resistor *R*, since the steady pressure of the machine is balanced by the steady pressure of the battery. If the switch *S* is opened and the brushes placed in the neutral position, the pulsations so obtained are due to the presence of the armature teeth, and due also to the fact that the number of commutator segments is not indefinitely large. If the switch *S* is closed and the machine loaded, the pulsations due to commutation are obtained superposed on the pulsations due to the teeth, etc. If the test is carried out on a motor the compensating battery may be dispensed with, and the pulsating e.m.fs. separated by connecting the oscillograph circuit to the secondary of a series transformer inserted in the armature lead. In order to avoid undue saturation of the transformer core, a direct current should be sent from a low-voltage battery through a second opposing primary winding, in series with which a coil of high self-induction is connected.—Lond. *Electrician*, May 27.

Alternating-Current Commutator Motors.—A. Fraenckel and B. J. M. Lane.—The conclusion of their illustrated paper on short-circuit losses in alternating-current commutator motors. Results of experimental researches on the losses due to the short-circuit currents in alternating-current commutator motors are given. These show a rapid decrease of the loss with increasing speed, other conditions being equal. An explanation of this phenomenon is given, and oscillograms are shown from which the decrease of the short-circuit current with increasing speed, and for a given short-circuit e.m.f., is deduced. The influence of the short-circuit currents on the line pressure and current is illustrated.—Lond. *Electrician*, May 27.

Commutators for High-Speeed Machines.—A note on a recent British patent (10,588, 1909; May 19, 1910) of C. A. Parsons, A. H. Law and J. P. Stockbridge. To avoid taking up useful brush surface by external rings, the segments are held in against centrifugal force internally by providing the hub with

dovetail or T-shaped longitudinal projections which fit into corresponding recesses formed by cutting pieces out of two adjacent segments. The projections are insulated from the segments, and wedges are provided. An alternative method consists in passing radial bolts through the hub. The bolts may either lock or screw into the bars. A description is given of another construction in which the adjacent bars are locked into one another, thereby forming a stiff ring capable of supporting itself.—Lond. *Elec. Eng'ing*, May 26.

Windings.—The first part of a serial on the arrangement of the windings in dynamo-electric machinery. Introductory notes on the difference between alternating-current and direct-current windings, on the principal forms of coils employed, and on the throw of a coil, are given by R. A. Smarth, while J. I. Stadeker deals with small direct-current machines.—*Elec. Jour.*, June.

Synchronous Motors.—A. GHEYSENS.—With reference to the recent article by Isanbert, the author discusses the differences between the vector diagrams for the synchronous alternating-current generator and the synchronous motor, and then deals at greater length with the motor diagram.—*La Lumière Elec.*, May 21.

Moore Vapor-Tube Lamp.—W. WEDDING.—The conclusion of his account of an investigation of the Moore vapor-tube lamp. Oscillographs are given of the voltage and current curves of the vapor-tube lamp, which is then compared with other lamps, first with an incandescent carbon-tube lamp, the author putting together carbon-tube lamps side by side in a row so as to produce an effect similar to the vapor-tube lamp. For the Moore lamp he finds a specific consumption of 1.535 watts per candle-power, for the carbon lamp 2.82 watts, and for the tungsten lamp 1.253 watts. The advantages of the Moore tube lamp are the uniformity of illumination and the color of the light. A disadvantage is the poor power-factor. The economy of the lamp increases with the size of the installation—that is, with the length of the tube. But in such cases some other lamp installation for emergency cases seems necessary, unless it is preferred to subdivide the tube into two or three parts and use series-parallel instead of pure series connection.—*Elek. Zeit.*, May 26.

Metallic-Filament Lamps.—A note on a recent British patent (17,960, 1909; May 19, 1910) of Felten & Guilleaume Lahmeyer-Werke A. G. In order to prevent disintegration of metallic filaments a nitrogen compound free from hydrogen, such as phosphorus nitride, is introduced into the bulb in the form of a paste on some part of the interior. This gradually liberates nitrogen throughout the life of the lamp. It has been found that hydrogen introduced for this purpose becomes ionized and conducts a comparatively large current, thus short-circuiting the filaments. Nitrogen is said to be free from this objection owing to its smaller molecular velocity. To increase the absorption of oxygen, amorphous phosphorus may be mixed with the phosphorus nitride.—Lond. *Elec. Eng'ing*, May 26.

Moore Vapor-Tube Lamp.—An illustrated article on the use of the Moore carbon-dioxide lamp for color matching in an installation in Bradford, England.—Lond. *Elec. Eng'ing*, May 26.

Traction.

Electric Traction in France.—A description of various new interesting electric traction lines in France. The first one described is a tramway in the city of Lyons employing direct current at 600 volts in the city and single-phase current at 6000 volts in the suburbs. The line from Villefranche to Bourg-Madame is operated with direct current; water-power is used, the generators being of the combined direct-current and three-phase type; the three-phase currents are raised in voltage to 20,000 for transmitting energy to substations where conversion is made to direct current. The direct-current Lille-Raubaix-Tourcoing line, with double-catenary construction, is described as are also various lines of the Compagnie des Chemin de Fer du Sud de la France, employing single-phase traction at 6000 volts with a frequency of 25.—*L'Industrie Elec.*, May 25.

Project of Electrification of the Bavarian State Railways.—ZEHME.—The conclusion of the report based on an investigation made by Gleichmann, concerning the practicability of electrifying the Bavarian State railways. The conclusion is reached that the introduction of electric traction is possible. Electric traction can compete with steam traction if the cost of electric energy is below a certain critical value and if the traffic density is above a certain critical value. The water-powers of Bavaria are sufficient to furnish the energy required for traction. However, military and commercial reasons may oppose it. A final decision can be reached only from practical experience.—*Elek. Zeit.*, May 26.

Surface-Contact System.—An editorial note on troubles experienced with live studs with the Dolter surface-contact system in Torquay, in England. Live studs have been noticeable at Torquay to a larger extent that the Board of Trade think desirable. Certificates have been issued from time to time permitting the system to continue in use, but with the intimation that the conditions must improve. Some little time ago a certificate was issued by the Board of Trade for one year, with the proviso that if matters did not improve within the first six months of that time no further certificate would be granted. This period has now expired, but, unfortunately, there has not been the desired improvement, and consequently the Town Council are considering what are the best steps to be taken.—Lond. *Electrician*, May 27.

Installations, Systems and Appliances.

Switzerland.—M. DE COPPET.—A review of the electric stations of Switzerland. At the end of 1907 there were 607 electric supply stations, but information as to their equipment, etc., was obtainable from only 266 stations. These are the more important ones. Among these 266 stations, there are 173 which have their own power plants and 93 which buy energy in bulk from other stations. A large majority of the 173 stations—namely, 152—use water-power either alone or together with steam power. The mean first cost invested per kilowatt is $207 for the pure water-power stations, $265 for combined water and steam stations, and $627 for stations using gas power alone. Out of the 173 stations 57 produce direct current, 85 alternating current, and 31 both direct current and alternating current. The length of the most extended transmission system is 682 km (410 miles, that of the most extended distribution system 819 km (490 miles), both employing overhead wires. The maximum distance over which electrical energy is transmitted is 100 km (60 miles). The aggregate rating of the hydraulic turbines and steam engines and of the electric motor-generators which are supplied with energy in bulk from other stations is

TABLE I.—COST OF ENERGY FOR LIGHTING.

	Price per kw-hour	
	1903	1909
Municipal Stations:		
Aarau	12 cents	12 cents
Bellinzona	8	8
Berne	13	13
Geneve	6.6	1.6( )
Lausanne	14	10
Le Locle	12	12
Lugano	10	8
Neuchâtel	11	10
Saint-Gall	14	13
Schaffhouse	12	12
Zurich	16	10

289,865 hp, their number, 752, giving a mean of 385 hp per generator. The possible output of the water-power stations of Switzerland has a maximum of 213,000 hp and a minimum of 132,870 hp at times when the water is low. The rating of the motors and lamps connected to the 173 stations is 206,800 kw. Of these there are 87,300 kw in motors, 102,500 kw in incandescent lamps and 17,000 kw in heating apparatus, etc. All these figures refer to the end of 1907. At the present time the figures would be probably about 20 per cent higher. The development of water-powers in Switzerland began in 1886, and

a sketch is given of this development. As to the price charged for lighting Table I gives the charges in 1903 and 1909 for 11 municipal stations.

The charges for industrial purposes in various representative municipal and company stations are given in Table II.

TABLE II.—COST OF ENERGY FOR MOTORS.

	Price of hp-year of 3000 hours for a motor of			
	1 hp	10 hp	50 hp	100 hp
Municipal Stations:				
Geneve	$80.00	$53.60	$34.60	$28.00
Lausanne	80.00	56.00	43.00	43.00
Neuchâtel	60.00	44.00	32.60	32.60
Berne	54.40	42.60	35.00	32.00
Fribourg	50.00	39.20	35.00	31.20
Company Stations:				
Rheinfelden	$41.60	$39.20	$35.60	$33.20
Beznau	43.00	39.20	34.00	32.00
Kander	49.00	42.00	34.00	32.00
Hagneck	42.00	35.00	34.00	29.00
Montbovon	50.00	39.20	34.00	31.20
Kubel	80.00	55.00	36.00	31.20
Olten-Aarburg	44.00	40.00	34.00	31.20

As a result of the electrical development the import of coal to Switzerland has remained about stationary during the last 10 years.—*La Lumière Elec.*, May 21.

Electrical Industry in Austria.—E. Honigmann.—The first part of a report on the condition of the electrical industry in Austria and Hungary in 1909. The reasons why the development in these countries has been lagging behind that of the United States and Germany are explained. The Austrian electrical industry depends upon the German industry. The conditions of the market in Austria and Hungary have not been very favorable during the past year. Some improvement is hoped from a greater use of electricity in agricultural districts. Smaller firms making wiring installations, etc., have suffered severely from competition with larger firms and with central stations. Some statistical tables are added.—*Elek. und Masch.* (Vienna), May 22.

Gothenburg.—E. Wikander.—The first part of an illustrated description of the new municipal central station of the city of Gothenburg, in Sweden. The first Swedish central station was erected in Gothenburg in 1884. A second station was opened in 1888. Both have been very successful financially. The city is now itself entering the field with a municipal station, the rating of which will be 9000 kw. The article is to be continued.—*Elek. Zeit.*, May 26.

Wires, Wiring and Conduits.

Standardization of Fuses.—H. W. Kefford.—The first part of a paper read before the Birmingham Section of the (Brit.) Inst. Elec. Eng. After pointing out the desirability of standardization, the author gives particulars of tests on a number of representative types of fuses with ratings up to 50 amp, and discusses the ratio between the rated current and the normal fusing current. He then considers the general regulations for the construction of standard fuses and describes a non-interchangeable fuse system. He refers to the testing of fuses, and finally puts forward some suggestions as the basis of a specification for standard fuses.—Lond. *Electrician*, May 27.

High-Tension Cables.—M. Höchstädter.—A continuation of his article on the dielectric properties of modern high-tension cables, with reference to the use of cables for voltages above 20,000. The author deals with the dielectric loss, the capacity and insulation at varying temperatures and at varying voltages up to the perforation value for the cable. It is found that even under such conditions the true capacity of the cable remains constant and that the general form of the curve of the dielectric loss indicates the spontaneous occurrence of the perforation of the cable without preparatory internal changes within the cable. The dielectric power loss of different types of cables is investigated and it is shown that it cannot be represented in general by a simple formula. The article is to be concluded.—*Elek. Zeit.*, May 26.

Electrolysis of Cables.—F. Fernie.—A continuation of his article on electrolysis of electric cables. The author deals with the electrolytic corrosion of armored cables and then discusses electric osmose as another cause of deterioration, which causes an accumulation of moisture at the negative conductor if there is any current in the insulation.—Lond. *Electrician*, May 27.

Electrophysics and Magnetism.

Resonance in Alternating-Current Circuits.—O. Martienssen.—In the discussion of resonance phenomena in an alternating-current circuit containing an inductance and capacity in series, it is usually assumed that the inductance coil contains no iron. In the present investigation the author takes account of the change of the permeability of the iron with magnetization. He shows that if this is done the theory predicts phenomena which should differ in various respects from those of the usual theory. His theoretical results are then confirmed by experiments. The chief results are that in an alternating-current circuit which contains condensers and inductance coils with iron, the occurrence of appreciable resonance phenomena depends not only on the frequency, but also on the voltage. If the voltage is sufficiently high, strong resonance can occur within wide limits of frequency as long as the self-inductance is above a certain value. Under this condition the current is not a distinct single function of the voltage and frequency. Within certain limits of voltage and frequency there correspond two stable currents to the same frequency, one of these being considerably higher than the other. Between these two values there is a third value representing, however, an unstable condition. With resonance the wave-form of the current is not sinusoidal, but rather sharply pointed. Strong higher harmonics, especially the third harmonic, occur even if they are not present in the wave-form of the voltage of the new work.—*Phys. Zeit.*, May 15.

Effect of Dust and Smoke on the Ionization of Air.—A. S. Eve.—An account of an investigation, using the instrument or "ion-counter" of Ebert, on the effect of dust and smoke on the ionization of air. With a constant ionizing source, such as the gamma rays from 14 mg. of radium bromide and a constant air current to the testing vessel, the number of ions detected is dependent on the purity of the atmosphere as regards dust, smoke, mist or other centers, and was found to vary as much as 50 per cent. The apparent excess of positive over negative ions is due partly to diffusion to the tubes traversed by the air, partly perhaps to a real excess, but also to the fact that both kinds of small ions, particularly the negative, rapidly combine with particles of smoke, dust or mist, and pass through the testing vessel undetected. Hence apparatus such as Ebert's measures the physical purity of the air rather than the intensity of the ionizing agents. The presence of dust, smoke, mist or other centers, charged or neutral, in the air, causes a transformation from small to large ions. In this way the total number of ions present may be increased, while the conductivity is diminished. In any region of air where a charge of one kind is predominant the effect of the presence of centers, neutral or charged, is to increase and accentuate the excess. This tendency must have an important influence on the variation of the potential gradient and on the production of thunderstorms.—*Phil. Mag.*, May.

Earth-Air Electric Currents.—G. C. Simpson.—An account of a method of measuring the current of electricity which is constantly passing between the earth and the air. The principle of the method is to keep an insulated plate placed on the ground at zero potential and to measure the change of charge which this entails. As to the daily variations of the earth-air electric currents the curves of the author shows that the potential gradient had its chief minimum and maximum in the early hours of the morning and evening, respectively. The conductivity was above the average during the night and early morning, and below during the day and evening. It is made probable that the dust is the chief agent by which the sunshine causes the diminution of the conductivity.—*Phil. Mag.*, May.

Change of Resistance of Metals in a Magnetic Field.—S. C. Laws.—Former investigations have shown that all metals change their resistance in a magnetic field, all except the magnetic metals increasing in resistance in all fields; except for bis-

muth, however, this increase is very small, being usually less than one-one-hundredth of 1 per cent for a field of 10,000 c.g.s. units. The effect of low temperatures has also been studied. The present authors have investigated cadmium, zinc and graphite at different temperatures. For these substances the percentage change $\frac{dr}{r}$ of resistance r in a magnetic field H, is proportional to H^2 for the range of fields used. This change of resistance in all cases increases at lower temperatures. For cadmium and zinc the value $\frac{Hdr}{r}$ at the temperature of liquid air is about 20 times as large as at atmospheric temperatures. The increase of resistance in the case of graphite is about 1 per cent in a field of 11,000 c.g.s. units at atmospheric temperatures; this is about equal to the decrease of resistance of nickel in the same field, and is many times as large as the change of resistance occurring in any of the non-magnetic metals hitherto examined except bismuth.—*Phil. Mag.*, May.

Homogeneity of Gamma Rays.—F. AND W. M. SODDY AND A. S. RUSSELL.—An account of an extended investigation in which the general conclusion is reached that initially the primary gamma rays (at least of radium) are homogeneous and, since the beta rays are not homogeneous, further support is obtained for the view that the two types of rays are probably not interdependent.—*Phil. Mag.*, May.

Forces Between Atoms and Molecules.—R. D. KLEEMAN.—On the basis of a systematic investigation of the properties of the surface tension of different liquids the author endeavors to find some general laws as to the nature of the forces of attraction between atoms and molecules. The paper is highly theoretical.—*Phil. Mag.*, May.

Units, Measurements and Instruments.

Recording the Deviations of a Ship.—An illustrated description of an apparatus for automatically recording the deviations of a ship from the true set course. The compass card is slotted and is suspended in a conducting liquid. Any movement varies the resistance between fixed electrodes above and below the card, and the resulting fluctuations in current are caused to influence a mechanism so that any deviation is recorded.—Lond. *Elec. Eng'ing*, May 26.

Telegraphy, Telephony and Signals.

Wireless Telegraphy and Telephony.—An illustrated article on the Helsby wireless telegraph and telephone systems. A description is given of their system of wave telegraphy, the principal feature of which consists in the production of a spark discharge with a high and uniform group frequency by an electric method instead of by mechanical means. The method consists in rectifying high-tension alternating current and charging

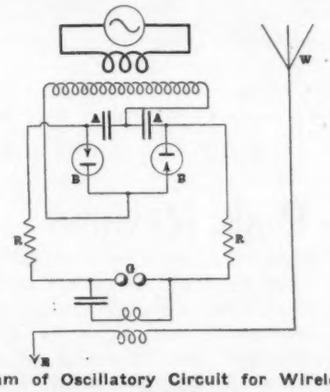


Fig. 2—Diagram of Oscillatory Circuit for Wireless Telegraphy and Telephony.

condensers with a high unidirectional potential, a small proportion of the charge being withdrawn continuously to energize the actual oscillatory circuit. In the diagram of Fig. 2 the secondary circuit of a transformer supplied at a normal frequency is connected to two condensers *A A* and two electric valves *B B* in such a manner that the condensers are kept charged to constant direct potential. As the condensers are in series the total potential across the spark-gap *G* is equal to twice that of the rectified alternating potential. The condensers are connected to the spark-gap through resistances *R*, which determine the rate at which the potential rises across the gap. Thus the group frequency or the interval between the

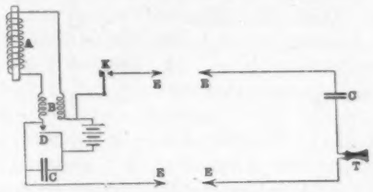
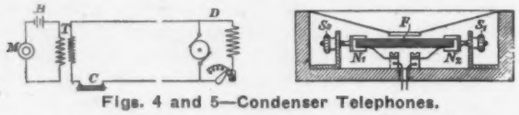


Fig. 3—Diagram of Connections.

discharges or the successive wave trains is governed by the capacity of the condensers *A A*, the break-down voltage of the spark-gap and the value of the resistances *R*. There can be obtained a group frequency of about 4000 cycles per second which corresponds to a fairly high note. The wave-length of the transmitted radiations is determined mainly by the dimensions of the aerial, which is inductively coupled to the oscillatory circuit in the usual manner. Resistances formed by the distilled water, covered with vaseline to prevent evaporation, are employed for *R R*, but rotary carriers can be used for transferring the charge from the condensers *A A* to the spark-gap electrodes, thus obviating Joulean heat losses. A novel feature of the apparatus is the multiple spark-gap. The discharge is broken up into four portions in series. The device is enclosed in a glass cylinder and is remarkably noiseless. The receiving apparatus contains no unusual feature, except in the construction and arrangement of the tuning devices. The same company is experimenting with a system of wireless telegraphy and telephony making use of the conductivity of the earth. A powerful momentary current impulse is sent between the extreme points of a base line by means of earth plates or rods buried in the ground, and the stream lines spread out on both sides of the base line. If two further earth plates are sunk within a certain distance so as to form a corresponding base line parallel or nearly parallel to the first, a difference of potential will be produced between them, and if the plates are joined up by a telephone a current impulse will be received. A strong current impulse of very short duration is produced with the aid of an inductance with a very small total expenditure of energy. The connections for both the transmitting and receiving ends for Morse telegraphy are shown in Fig. 3. There is a local circuit comprising a battery, an inductance *A*, and a high-frequency trembler *D* with its two exciting coils *B*. When signaling, this circuit is permanently closed, and the inductance is continually discharging into the condenser *C*, which prevents serious sparking across the trembler contact. The core of the inductance *A* is constructed in a similar manner to that of the induction coil used by the company for wireless work, and as the eddy currents are reduced to a minimum, the flux built up by the excitation of the inductance on the closing of the contact at *D* collapses very suddenly at break, thereby inducing a very high momentary back e.m.f. A series of these momentary high-tension impulses is thus produced, the frequency being equal to that of the trembler. Now, if the key *K* is depressed a train of these impulses is sent through the earth from plate to plate and the lines of flow cutting across the two receiving earth-plates cause a similar succession of very feeble current impulses to pass through the telephone *T* and the condenser *C*. The trembler is adjusted so that a musical note is heard in the telephone. With 14-yd. base lines and an expenditure of only a few watts, communication has been effected with this apparatus over a distance of nearly four miles. For wireless telephony on the same principle the trembler *D* is replaced by a microphone, and the transmitting circuit is closed permanently at *K*. When spoken to, the microphone practically makes and breaks the circuit of the inductance at frequencies corresponding to the sound waves impinging on the

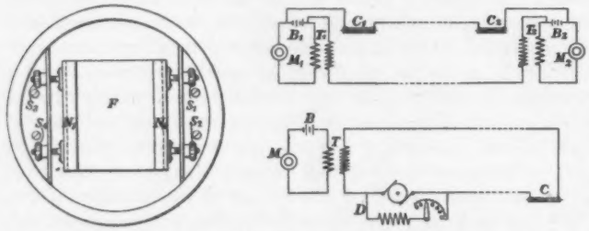
diaphragm. The high-tension impulses produced are conveyed to the transmitting earth circuit, and these cause corresponding current impulses in the telephone T of the receiving circuit. Thus the sound waves impinging on the microphone diaphragm are reproduced by the receiving telephone. Speech has been transmitted clearly by this method up to distances of 1.5 miles with the expenditure of only a few watts, and using base lines of only 14 yd.—Lond. *Elec. Eng'ing,* May 26.

Condenser Telephones.—An illustrated description of the condenser telephones made by C. K. Ort and J. Rieger. Many years ago it was observed that ordinary tinfoil condensers provided with paper insulation would give out notes when the foils were charged up to potentials of several hundred volts. Telephones of this type were constructed by Varley and by Dolbear, and later by Dunand and by Marshall. They all required high-tension batteries, however. In their experiments Ort and Rieger started from the well-known combination, due to Duddell, of an arc lamp fed by direct currents, with a condenser and a coil in a shunt. The burning of the arc produced current fluctuations in the shunt circuit which were audible. This combination was soon replaced by the arrangement illustrated in Fig. 4, in



Figs. 4 and 5—Condenser Telephones.

which M is a microphone, B a battery and C a condenser. Potentials of more than 25 volts were, however, needed to secure fair articulation. It was noticed, moreover, that the free edges of the sheets of tinfoil oscillated in an irregular manner, interfering with distinct articulation, and the experimenters also ascribed high hysteresis effect to the paper insulation. The sheets of tinfoil were, therefore, clamped, and the insulation was effected by means of shellac. Figs. 5 and 6 illustrate the new apparatus. The layers of tinfoil F are clamped at N_1 and N_2 and kept stretched by the screws S_1 and S_2. Fig. 7 shows another arrangement. The terminals of the condensers C_1 and C_2 are joined to batteries of two or three cells, which are inserted in the microphone circuits. With another arrangement, again, one battery sufficed; but loud sounds, which would be audible all over the receiver-room, required more than the 15 dry cells which were used on an experimental line of five miles' length, and the experimenters returned to the generator as the source of current. As a low current density suffices, a small generator will do. In Fig. 8 the secondary of the microphone transformer T damps the common current fluctuations in the generator circuit, which would otherwise be unpleasantly noticeable. The microphone currents, on the other hand, react on the generator circuit, as in the case of the speaking arcs. A more efficient connection is indicated in



Figs. 6, 7 and 8—Condenser Telephones.

Fig. 9. A special coil S_2 of several turns is wound over the shunt coil of the generator and joined to the microphone M and the battery B. The condenser is connected with the generator terminals. Other combinations are possible. The chief point seems to be to keep the potential sufficiently low—that is, below the natural vibrations of the sheets of tinfoil. As a consequence, the articulation is superior and stronger microphones can be used, yielding higher potentials, in the secondary, so that the intensity of sound is increased. For the ordinary telephonic service the dimensions of the condensers as built by Ort and Rieger are small—1.5 in. x 2.5 in., the capacity ranging from 0.015 up to 0.04 microfarad. When loud speaking is desired, larger dimensions—8 in. x 4 in.—and higher capacities, up to 1 microfarad, are required for the condensers, and the potentials, which will range from 4 volts up to 20 volts in the first instance, may have to be raised to 120 volts. In the latter case a generator will be the source of current. Earth currents, it is also claimed, have no influence upon these condenser telephones, and if the condenser is made of gold foil and rubber the telephone may be used also in rooms exposed to

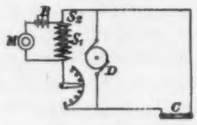


Fig. 9—Condenser Telephones.

dampness and acid vapors. With the aid of an ordinary plug contact the telephones may be worked from the leads of an electric lighting installation.—Lond. *Engineering,* May 27.

Electrodynamic Telephone.—M. Reinganum.—A description of a very simple form of electrodynamic telephone. It consists of a thin aluminum foil, through which the microphone currents pass, placed within a strong magnetic field. This telephone possesses the advantage of having very small capacity and self-induction and of the absence of detrimental damping, and is especially suitable as a zero instrument for measurements. Whether it would be of use in telephone practice would depend on the question whether a sufficiently strong magnetic field can be easily produced at sufficiently low cost.—*Phys. Zeit.,* May 15.

Loaded Telephone Cables.—A. W. Martin.—The conclusion of his long serial giving details of results obtained with telephone cables loaded with Pupin coils. A few notes on continually loaded cables (in which each conductor of the loop is covered with one or more layers of finely drawn iron wire) are added.—Lond. *Elec. Rev.,* May 27.

Miscellaneous.

Brussels Exhibition.—The first part of a sketch of the various electrical exhibits at the Brussels National Exhibition. In the present installment various direct-current and alternating-current generating machines are dealt with.—Lond. *Electrician,* May 27.

Thawing Water Pipes by Electric Current.—An article giving notes on various methods used in the United States for thawing water pipes by electricity.—Lond. *Engineering,* May 27.

Incandescent Welding.—C. B. Auel.—An illustrated article describing the La Grange-Hoho process and more in detail the Thomson process of electric resistance welding.—*Elec. Jour.,* June.

Free Trade or Tariff.—An account of a discussion before the National Electrical Manufacturers' Association in London on the effect of free trade or protection upon the electrical industry. The case for free trade was represented by J. E. Kingsbury; the case for protection by H. Hirst. A general discussion followed.—Lond. *Electrician,* May 27: Lond. *Electrical Review,* May 27.

Book Reviews

Hydroelectric Developments. By Preston Player. New York: McGraw-Hill Book Company. 68 pages, ills. Price, $1.

The development of water-power for producing electric energy is always preceded by a study to determine the value of the proposed development. Mr. Player has produced in this book a valuable guide for making such preliminary studies. The pure engineering side is not treated, but the financial side is covered with considerable detail. The problem is taken up at the beginning and a complete outline given as to what should be done, how it should be done and in what order. This outline includes all engineering work and financial studies. The engineering examination is briefly outlined and then the financial study is taken up in detail, chapters being devoted to the follow-

ing subjects: Study of the market; cost of energy manufacture; central-station economics; sale of electric energy; primary and secondary powers; capital costs.

THE THEORY OF ELECTRONS. A Course of Lectures in Columbia University in March-April, 1906, by Prof. Dr. H. A. Lorentz, of Leiden University. Publication No. 2 of the Ernest Kempton Adams Fund for Physical Research. New York: Columbia University Press. Quarto, 331 pages.

This published series of lectures probably forms the most valuable and complete modern text-book extant on the subject of electrons from the standpoint of mathematical physics. The electronic theory of emission and absorption of heat is fully discussed, together with the electromagnetic mass of matter. A large portion of the volume is devoted to a discussion of the Zeeman effects, both direct and inverse. Both of these effects are explained by the electronic theory in a relatively simple and very convincing manner. In fact, it is not too much to say that the Zeeman effects have established the Lorentzian form of the electronic theory. A final chapter is devoted to a consideration of optical phenomena in moving bodies, the experiments of Michelson, Morley and Brace, the phenomena of relativity and the theory of Einstein. The book will be of great value to the student of theoretical physics and is likely to be a permanent classic reference.

The same work has also been published in English by Teubner, Leipzig (9 marks), as a volume of his monumental series of works on the mathematical sciences.

New Apparatus and Appliances

SOLDERING PAINT CANS BY ELECTRIC HEAT.

The cans in which paint is supplied to the retail trade are commonly filled, inverted, through openings in the center of their tin bottoms. After the paint has been poured in to the proper height, this hole is closed by a tin cap soldered into place with a special tool which applies its heat around the edge of the cap. Such soldering appliances may be obtained either as hand tools, or in gangs mounted on a driving shaft and adapted to seal several cans simultaneously. Heretofore they have been heated by gas, especially in the case of those of the

Soldering Paint Cans by Electric Heat.

machine-gang type, a special burner being arranged to impinge its flame on the slowly-rotating soldering heads.

The machines illustrated in the accompanying view were originally constructed for gas-heated operation, but electrically heated units have recently been installed to replace the former externally gas-heated heads, with decided improvement in economy, cleanliness, comfort, speed and safety.

Using the capping machine illustrated, the cans, with caps in place and having been previously brushed with flux, are centered in position by the aid of V-shaped guides, which bring them into position under the slowly rotating heads. By means of a lever, the whole row of three or six of these heads, which run at about 22 r.p.m., is then pressed down onto the rims of the caps, meanwhile solder is fed by hand against the cap joints, closing them completely.

One man, using three electrically heated heads, is able to seal from 2000 to 2500 cans in a 10-hour day. Formerly, with the gas-heated machines, two men and all six of the soldering heads were required to turn out an equal number of cans. Under the old conditions, too, a much more minute inspection of the sealed cans was required than is now found necessary with the satisfactory work performed by the electrically heated tools. The old gas burners set to impinge their flames against the soldering heads were at a height about that of the operator's head, projecting their heat and fumes into his face and rendering the work particularly uncomfortable and unhealthful.

The former gas soldering heads have now been replaced by internally heated electric units, similar to those employed in large-size soldering tools. The resistor units are energized through brushes bearing on slip-rings carried by the rotating shafts, the whole structure being so combined as to be adjustable, to allow the soldering head to be raised or lowered through several inches, for different sizes of cans. Each resistor element consumes about 400 watts.

The electrically heated machines give none of the discomfort experienced with the open-flame heaters. The absence of flame also prevents the ignition of fumes and vapor issuing from the can and the burning of paint and oil which has spattered on the can tops, which made soldering with the gas-heated units frequently unsatisfactory. Absence of open flame is, of course, a most important consideration in a paint factory where large quantities of oil are exposed, for reasons of safety.

With the small hand capping-tool, shown at the left on the illustration, the operator can seal about 1000 cans in a day. This latter tool can be carried about the plant, for use at any point where the cans are being filled, thus avoiding the necessity for transporting the filled cans to the soldering room.

With the two machine-soldering tools and one hand tool shown, about 6000 cans can be capped and sealed by three men in a 10-hour day. These special electric soldering appliances were built and supplied to the Devoe-Reynolds Paint Company, Chicago, owner and operator of the machines illustrated, by the Vulcan Electric Heating Company, Chicago.

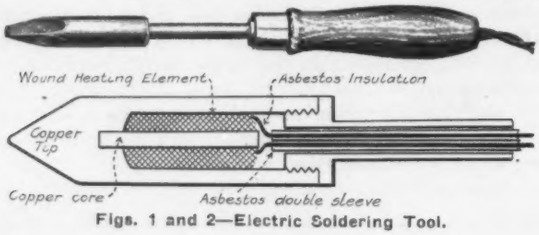
IMPROVED ELECTRIC SOLDERING TOOL.

A large part of the heat developed in some electric soldering tools goes to supply the losses of radiation and convection occurring from the heated head, while only a comparatively small portion is usefully applied at the tip in melting solder or heating the work. A type of electric soldering tool looking to improved facility in the conduction of heat from the resistance unit directly to the working tip is shown in the accompanying sketch.

The feature of this tool is in the arrangement of the heating element, which is enclosed within the soldering head, thus providing a large contact surface for the conveyance of the heat directly into the copper soldering tip. The transfer is further

aided by the extended copper core on which the resistance wire is wound, and which makes a tight-fitting joint into the center of the tip.

The ample heat conductance thus secured between the tip and the coil, both inside and outside, is thus responsible for the comparatively small amount of electricity required by this iron, the largest part of the heat developed being carried



Figs. 1 and 2—Electric Soldering Tool.

directly and efficiently to the working surface. The heating element is designed to develop just enough heat to keep the copper tip at the proper temperature while working. There is a minimum loss in transmitting heat to the tip, since the construction avoids the use of any other metals which are poor conductors compared with copper. No damage will result from leaving the current on while the tool is not in use, the manufacturer asserts. It is said that several irons have been tested for over 1000 hours' continuous run.

The Waage electric soldering tool, just described, is made in six sizes. Three smaller sizes, consuming 40 watts, 50 watts and 60 watts respectively are each under 11 in. in length, and the larger tools, taking 90 watts, 120 watts and 140 watts are less than 12 in. long, making them all of convenient form to be carried in a tool-box.

Attention is called to the comparative saving in cost of using this electric iron as against the gas-heated tool. At 10 cents per kw-hour the cost of operating a No. 10 tool for a 10-hour day is only 4 cents, while a gas-stove used to keep a pair of small irons hot would cost from 15 cents to 20 cents a day. In this way, asserts the manufacturer, the cost of the electric soldering iron can be recovered in a month. The Waage electric soldering tool is made by the Waage Electric Company, 674 West Madison Street, Chicago, for which the Illinois Appliance Company has been appointed sole sales agent.

FOUR-VALVE WATER STRAINER.

The water strainer shown in the accompanying illustration is made in two types, one with the top drive and the other with the side drive, the latter being used in vacuum work

Fig. 1—Water Strainer.

where air leakage when cleaning is not permissible. On the side drive type the screw that passes up through the lower valve is surrounded by a tube in order that there can be no leakage through the threads of the screw passing through the lower valve. For pressure work and service in which a small leakage of air can be neglected, the top drive, being cheaper in construction, is generally employed. Both types are made in one casting, and each has four valves, two valves per set. When in use the water is always passing through one of the strainer baskets, entering the top, the other one being, if necessary, cut out for cleaning purposes.

In the condition shown in cuts, the water is passing through the right-hand strainer, the left-hand straner, being raised up, is ready to be taken out for cleaning, which can be readily done by removing the cover. The strainer slips over the valve stem, the dirt is dumped out, the basket replaced, the cover put on again and the basket is ready for service when the other becomes clogged up.

The strainer is manufactured by the Liberty Manufacturing Company, of Pittsburgh, and is recommended for cases where

Fig. 2—Water Strainer.

the water does not contain very large quantities of foreign matter. Being much cheaper in construction than the twin type, there are many places where it can be used and where it works satisfactorily under these conditions.

NEW FACTORY OF THE COOPER HEWITT ELECTRIC COMPANY.

The demand for Cooper Hewitt lamps having entirely outrun the capacity of the New York City factory, for several months the company had been looking for a suitable site or building, and has recently purchased a substantial structure located at the corner of Grand and Eighth streets, Hoboken, N. J. The new location affords the advantages of the best of light and air, and the railroad and shipping facilities are equal to those of the metropolis, while recent rapid transit facilities place the building within 20 minutes' ride of either the financial or uptown sections of New York.

The new factory will be equipped as rapidly as possible with the most modern machinery and devices for the manufacture of the Cooper Hewitt lamp. Power and electric-current will be supplied by the Public Service Corporation of New Jersey. The new alternating-current type of Cooper Hewitt lamp will be the first to be manufactured in the new plant, the work on this lamp to begin as soon as the requisite machinery can be installed.

The building has four stories and a basement, with a total floor space of 60,000 sq. ft. The building is divided in the center of its length by a 16-in. fire wall, all openings in which are guarded by sliding fire doors equipped with low-temperature fuse releases. An elevator gives access to all floors on either side of the fire wall. The entire building is equipped with a combination gravity and pressure sprinkler system. The machine department will be equipped with electric motors, which will be arranged for individual and group drives.

PEERLESS TESTING SET.

A new testing set of the switch, decade-dial type has just been placed on the market by the Thompson-Levering Company, Philadelphia. The rheostat is composed of four dials corresponding to units, tens, hundreds and thousand ohm coils, 10 coils to each dial. The bridge arms have values of 1 ohm, 10 ohms, 100 ohms and 1000 ohms to each arm, thus giving a very wide range of measurement.

The set is equipped with quick make-and-break switches, enabling the tester to go rapidly from one test to another and

Peerless Testing Set.

making manipulation very easy. The brush is of a special design, made of spring phosphor bronze, and so designed as to insure an excellent spring contact. The brushes are carefully ground and slide over the contacts evenly and smoothly, the contact resistance being negligible. Another feature in connection with these brushes is the fact that they can be swung from the highest to the lowest value coil without going over the intermediate blocks, thus making a complete circle and saving a great deal of time over the old methods.

An Ayrton shunt forms part of this apparatus, allowing the use of full current, or one-tenth part or one one-hundredth part to flow through the galvanometer of the set, or an outside galvanometer, as desired. The galvanometer is of the D'Arsonval type and has a very high sensibility. It is quick and positive in its action, and extremely dead-beat, thus enabling readings to be made easily and quickly. The galvanometer key is arranged with a short-circuit device, which also helps to bring the needle to rest promptly.

The battery in the case consists of four commercial cells, which is a big advantage over the use of special cells which necessitate sending to the maker for new cells whenever they are required. The cells are replaceable by removing four small screws, which release the cell block; this block, when filled, is then slipped back into place and screwed in, the operation taking but a very few minutes. The rest of the set is undisturbed.

Provision is made, by means of binding posts on the set, for an outside battery in case a higher e.m.f. is required than that of the cells contained in same. Provision is also made, by means of binding posts, for the use of an outside galvanometer in case a very high sensibility instrument is required for special insulation measurements.

The rheostat coils are adjusted to an accuracy of one-tenth of 1 per cent, and the bridge-arm coils to one-twentieth of 1 per cent, so that these coils, in connection with the high sensibility of the galvanometer, allow very accurate readings to be taken. The set is perhaps the smallest yet produced, being 9¼ in. long by 5¾ in. wide by 5½ in. deep, and weighs but 7¾ lb. The case is of mahogany, handsomely polished, and all of the metal work is brass lacquered.

HIGH-TENSION PORTABLE TESTING OUTFIT.

A small portable testing outfit has recently been developed by the Westinghouse Electric & Manufacturing Company to meet the demand from central stations, railway plants, car barns, repair shops, etc., for a portable testing device that will give an alternating voltage sufficiently high to test armature coils, meters, switches, and other details that are used in low-tension systems and require an insulation test varying from 500 volts to 2000 volts. Such an outfit should be "foolproof," as it must often be handled by men not familiar with high voltage; it should be semi-portable; it should afford a sufficient number of steps in the testing voltage; and last, but not least, it should be comparatively inexpensive.

The outfit offered for such service, illustrated herewith, has a rating of 0.5 kw, and provides different testing voltages up to and including 2000 volts in 100-volt steps. It is designed for use on circuits of any frequency from 25 cycles up. Either a 110-volt or 220-volt primary may be supplied. This capacity will be found sufficient for any normal testing up to 2000 volts. The 110-volt low-tension side may be connected to any source, such as a lamp socket, wall receptacle, etc.

The neat wooden box in which the testing transformer is mounted is approximately 9½ in. x 12½ in. x 14¾ in., and the weight is only 60 lb. Two cast-iron handles are provided so that the box can be very conveniently carried about.

The testing voltage is varied by means of two small rheostat dials mounted within the box. To the contacts of the dial are brought the taps from the high-tension winding of the transformer. Any voltage from 100 volts to 2000 volts can be obtained in 100-volt steps.

The rheostat dials, as well as the high-tension binding posts, are mounted within the box. When the hinged cover is lifted to change the dial setting, the low-tension primary circuit is automatically opened, so that the box is absolutely "foolproof" against any touching of the dials, binding posts, etc., while the

High-Tension Testing Outfit.

transformer is excited. Two high-tension testing leads, consisting of rubber-covered cable, passing through rubber tubing, are brought out of the box and provided with heavily insulated terminals, so that they may be handled with perfect safety by the tester.

A pilot lamp, connected across the low-tension primary circuit and mounted on top of the box, promptly indicates when the primary circuit is closed. A plug switch and fuse holder are provided in the primary to protect and control the circuit.

Industrial and Commercial News

The Week in Trade.

THE remarkably unseasonable weather of the past week has not only retarded crop development all over the northern half of the country, but has acted as an almost complete check to retail trade. Throughout this entire section, where cold and rainy weather has prevailed, retailers have done but little business. Also in the southern section of the country trade is quiet, although in this district both the cotton and fruit crops are making fairly good progress. The wholesalers and jobbers report that their business is very quiet owing to the stagnation in retail trade, and that even the volume of re-orders, which is not infrequent at this period of the year, is much smaller than usual. All trade as a whole is lifeless. This is due to uncertainty as to crop and price conditions. Industrial reports point to considerable curtailment of output, also due to the general feeling of uncertainty. In the iron and steel industry the outlook seems to be a trifle brighter than it was a week ago, and there is a more general feeling of optimism. This is due to the reversal of the position of the administration with regard to railroads. When the injunction suits were brought two weeks ago to prevent the advance in freight rates, many railroads called halts upon contemplated improvement work. Quite a number of orders were cancelled or contracts held up. With the compromise of last week, under which the railroads agreed to postpone the advance of rates until after the new schedules had been passed upon by the Interstate Commerce Commission, it is generally believed that this improvement work will go on. Aside from the unfavorable weather, the main feature of discouragement in the trade situation is the uncertainty which all merchants seem to feel with regard to future prices. No cautious retailer is willing to lay in heavy stocks at this time. Purchases of cotton goods and other textiles are extremely light, and many of the manufacturers are cutting down their output 50 per cent. Even building operations showed some falling off last week, and this has heretofore been the most active line of industry. The export trade is still dull, and shows the effect of high prices, which curtail the demand of foreigners for our farm products. Collections can be scarcely classed as fair. This condition is the natural sequence of the light retail trade. Business failures for the week ended June 9, as reported by *Bradstreet*, were 189 as compared with 160 the previous week, 197 in the same week in 1909, 253 in 1908, 161 in 1907 and 170 in 1906.

The Copper Market.

LITTLE encouragement could be found for a discouraged copper market in the report of the Copper Producers' Association for May, made public last week. It had been generally anticipated that the production would far exceed the takings by consumers and that a considerable increase in the surplus stocks would be made, but it was even larger than the pessimists figured. The addition to the surplus amounted to 18,441,814 lb. and the total stock reported by the Association at the end of the month was 160,425,973 lb., the largest amount carried over from one month to another since the end of May, 1909. Since the first of the year the addition to the surplus has been more than 62,000,000 lb. The full figures for May as collected by the Association were, production, 123,242,476 lb., the heaviest since last October; domestic deliveries, 59,305,222 lb.; exports, 45,495,440 lb., this total being 26,000,000 lb. less than in May last year. Such figures as these practically put an end to trading in the market. Prices were weak and reports of concessions being offered below official quotations were heard on all sides. Consumers were generally impressed with the opinion that better bargains could be obtained in the future and there was little inclination to buy. The unsettled condition of general business also had a tendency to prevent melters from accumulating heavy stocks. In addition the demand from abroad was very sluggish. The industrious speculators who last year helped so greatly to keep up prices have practically disappeared. Foreign bankers are not soliciting business on copper warrants and speculators are not encouraged to take long chances. Both at home and abroad there has been evidence of considerable anxiety to sell copper. Another discouraging feature of the market last week was the fact that the imports of copper since June 1 had exceeded the exports by almost 2000 tons. In the meantime there are no authoritative reports of curtailment. In fact some of the largest producers have specifically denied any such intention. Exports for the month, including June 13, have been 4378 tons. The daily call on the Metal Exchange June 13 quoted standard copper as per accompanying table.

Standard Copper.	Bid.	Asked.	Settling price.
Spot	12.05	12.25	.....
June	12.05	12.25	12.15
July	12.05	12.25	12.15
August	12.05	12.25	12.15
September	12.05	12.25	12.15

The London market, June 13, was as follows:

	Noon. £ s. d.	Close. £ s. d.
Standard copper, spot	54 18 9	54 15 0
Standard copper, futures	55 12 6	55 7 6

Extreme fluctuations for this year:

	Highest.	Lowest.
Standard	13.50c	12.05c
London, spot	£62 0 0	£55 2 6
London, futures	65 18 9	56 2 6
Best selected	65 10 0	59 10 0

Industrial and Commercial Notes.

Orders for Reciprocating Engines.—Some people have thought that the introduction of the steam turbine would practically drive the steam engine out of business so far as central station work was concerned, but that this fear is unfounded is indicated by a recent order received by Allis-Chalmers Company from the Illinois Traction System. This company controls and operates most of the urban and interurban traction lines in central Illinois and has power houses in the principal cities. It has just placed an order with Allis-Chalmers Company for four direct-connected engine-generator sets exactly alike. One of these will be put in the power house at each of the following cities: Danville, Decatur, Champaign and Galesburg. The engines have cylinders 32 x 48 and are of the heavy duty noncondensing Corliss type. Each is direct connected to a 1000-kw 2300-volt, 60-cycle, 3-phase, 100 r.p.m. alternator. The load will be railway and lighting service.

Wireless on Union Pacific.—The experiments which have been carried on for some time by Frederick H. Millener, engineer for the Union Pacific Railroad, looking to the installation of wireless telegraph for train dispatching, are now announced as successful, and it is given out that the railroad will at once install wireless apparatus. Two stations are being equipped, one at Cheyenne, Wyo., and the other at Sidney, Neb. These stations are 103 miles apart, and the first use of wireless will be between them. It is not intended that the wireless apparatus will supplant the train dispatching system now in use, but it is being installed as supplemental and it is expected that it will be especially serviceable in times of heavy storms, when telegraph lines are rendered useless.

Alternating Current Equipment for Tennessee Mining Company.—The Ducktown Sulphur, Copper & Iron Company of Isabella, Tennessee, is changing over from direct to alternating current 440-volt, 3-phase, 60 cycles, involving an outlay of about $50,000. Variable speed induction motors and individual drive will be used to a great extent. The Westinghouse Electric & Manufacturing Company and the Westinghouse Machine Company secured the contracts for the new apparatus, which includes two 625-kw Westinghouse-Parsons steam turbines with direct-connected generator, power and lighting switchboard, and approximately 1000 hp in motors.

New River Power Company.—Baltimore and New York financiers are interested in the formation of the New River Power Company which has for its purpose the development of extensive hydroelectric plants on New River in West Virginia. Percy H. Goodwin of the Banking House of H. C. Brown & Company, Baltimore, is treasurer of the new organization, and is active in its promotion. The officers of the new company are: President, F. S. Viele; vice-president, Hugo Kohlmann, and secretary W. M. Blain, all of New York.

Balata Belting Factory.—Announcement is made that through a combination of German and American capital a Balata belting factory, involving an expenditure of half a million dollars for building and equipment, will be erected at Easton, Pa. Although Balata belting is much used in this country, none has heretofore been manufactured here, all the supply coming from Germany and England. It is said that during the past five years Balata belting to the value of one million dollars has been imported annually. The corporation behind the new enterprise is known as the Victor-Balata & Textile Belting Company, in which the American interests are represented by Charles E. Aaron and John R. Stein, president and treasurer respectively of the New York Leather Belting Company, and the German interests by William Vollrath, Albert Vollrath and Edwin Vollrath, of the firm of C. Vollrath & Sohn, of Blakenburg, Germany, which company is one of the largest textile belting manufacturing companies in Europe. The American company was the pioneer in first introducing Balata belting in the American market. The officers of the new combination are Charles E. Aaron, president; Edwin Vollrath, secretary; John R. Stein, treasurer. The factory site at Easton covers 9 acres of ground, and is located in the suburb of Palmer, to which the city has extended its limits in order to give the new plant the benefit of fire protection. Houses will be erected on the site for the workmen of the plant, all of the buildings to be of concrete. The machinery complete for the manufacture of the belting, as well as for the weaving of the cotton duck, will all be obtained from abroad and installed under the personal supervision of Mr. William Vollrath, senior member of the German firm. The new company also announces that it contemplates building several other factories on its site for the manufacture of other kinds of textile belts similar to those now made in the United States. It is expected that the new plant will be in full operation late in October.

Telephone Train Dispatching on Santa Fé Railroad.—Apparatus necessary to equip about 4600 miles of its line with telephones for dispatching trains has been ordered by the Atchison, Topeka & Santa Fé Railroad. The outside construction work is already well under way. Eventually all traffic and train movement on the Santa Fé will be directed by telephone. To-day 2275 miles of road are equipped with the telephone system. The Santa Fé was one of the very first to supplant the telegraph for this kind of work, and the accuracy of its operation has strengthened the belief of the officials of this road in the new dispatching system. The telephone equipment for the latest sections of this road to adopt this method of dispatching has just been ordered from the Western Electric Company. The telephone is soon to be installed over tracks from Newton, Kan., west to Mojave, Los Angeles and San Diego, Cal.; from Newton south to Gainesville, Tex.; from Temple, Tex., to Galveston, Tex.; from Temple to Brownwood, Tex., and from Wichita, Kan., to Clovis, N. M.

American Power & Light Company.—Announcement has been made that the American Power & Light Company has taken over the holdings of the Northwest Corporation of Philadelphia. This latter company was purchased by H. M. Byllesby & Company of Chicago, about a month ago, details of the transaction having been published in the issue of May 19. The transaction includes gas and electric properties in Walla Walla and North Yakima, Wash., Lewiston, Idaho and Pendleton, Ore. The American company has also acquired the Strahorn properties in North Yakima and along the valley of the Columbia River. These include the Northwest Light & Water Company and the Yakima Valley Power Company. These properties are connected by a 66,000-volt transmission line, more than 100 miles long reaching several towns in the valley. The American Power & Light Company is controlled by interests identified with the Electric Bond & Share Company.

Chicago as an Industrial Center.—N. W. Halsey & Company, bankers, of Chicago, have issued an interesting illustrated booklet bearing the title, "The Future Hub of Investments." With Chicago as a center, the pamphlet says that a circle having a radius of 40 miles may be struck, and this line will enclose the "great central exchange market, the great gateway between the manufacturer of the East and the agriculture of the West." This territory is also called "Man's Workshop." The booklet describes some of the industrial features of this area, with illustrations giving views of Joliet, Aurora, Elgin, Waukegan, Harvey and Chicago Heights. There are also maps of the region and of the territory served by the North Shore Electric Company, North Shore Consolidated Gas Company, Western United Gas & Electric Company, and Economy Light & Power Company.

Railroad Improvement Checked.—Bids for building 45 miles of electric railway from White Plains to Danbury, Conn., involving an expenditure of between $5,000,000 and $7,000,000 have been recalled and the work indefinitely postponed by the New York, New Haven & Hartford Railroad Company. This postponement is announced to be due to the action of the administration in regard to railroad rates. L. S. Miller, president of the New York, Westchester & Boston, the rapid transit electric line being constructed by the New Haven Railroad, has made a statement in which he said that, while his company had made all arrangements to go on with this work, it did not now feel justified in investing any more money in railroad property until the position of the President had been clearly defined. He said that the agitation over commutation rates had not influenced the company's action in this matter.

Public Service Corporation of New Jersey.—There has been incorporated at Newark the Public Service Electric Company with a nominal capital of $10,000. This incorporation is the first step in the plan of the Public Service Corporation of New Jersey, for separating the three departments of its service and having each managed by an individual company. The new company will control all the electric light and power concerns owned by the parent corporation. The gas properties and traction properties will each be controlled by separate companies. The incorporators of the new company are Thomas N. McCarter, president; Edwin W. Hine, secretary, and Dudley Farrand, general manager of the electrical department of the Public Service Corporation. The parent corporation will own all of the stock of the new company with the exception of the necessary directors' shares.

Electrical Construction.—Among the items printed under Construction News in our present issue are announcements of proposed new plants or considerable extensions of present plants at Alameda, Cal.; Youngstown, Ohio; Apache, Okla.; Livingston, Tenn.; Texas City, Tex.; Jackson, Ala.; Richmond, Va.; Whittier, Cal.; Slater, Mo.; Terrell, Tex.; Murray, Utah; Neillsville, Wis.; New Market, Ind.; Yerington, Nev.; Beach, N. D.; Lead, S. D.; Sheridan, Wyo.; Washington D. C.; New Castle, Pa.; Allentown, Pa.; Cleveland, Ohio; Los Angeles, Cal.; Grangeville, Ida.; Oroville, Cal.; Hartford City, Ind.; Fredericksburg, Va.; Tacoma, Wash.; G'oversville, N. Y.; Wilson, N. Y.; Cherokee, Okla., and Aliceville, Ala.

Illinois Utility Merger.—A fifty-year franchise has been granted to Charles A. Munroe, president of the newly organized Illinois Valley Gas & Electric Company. This is said to be the first step in a consolidation scheme which involves 26 Illinois cities and towns. The new company is a subsidiary of the Commonwealth Edison Company of Chicago, and is connected with the Economy Light & Power Company of Joliet. Samuel Insull is president of these two companies. The new corporation is capitalized at $6,250,000, and has an authorized bond issue of $10,000,000. It has already taken over the properties of the Illinois Light & Traction Company of Streator.

New General Electric Building at Lynn.—The General Electric Company has placed a contract with the Aberthaw Construction Company for a new reinforced concrete building at Lynn, Mass. The building is to be absolutely fireproof, 130 ft. by 51 ft., three stories. The exterior walls are to be reinforced concrete, frame paneled with brick, and with a very large window area. The floors and roof are to be of the girderless or mushroom type of reinforced concrete.

Panama Canal Electrical Purchases.—The Isthmian Canal Commission, Washington, has invited proposals for a list of electrical material, bids for which are to be opened June 24. The schedule includes lighting fixtures, measuring instruments, interior wiring fittings and material, wire, arc lamps, carbons, etc. Copies of the schedule (Circular No. 590) may be obtained from the Washington office.

Westinghouse, Church, Kerr & Company.—H. H. Westinghouse has been elected president of Westinghouse, Church, Kerr & Company, Ltd., to succeed the late Walter C. Kerr. The annual statement of the company for the year which ended March 31, 1910, shows total assets of $3,244,700, which was an increase of $535,266 over the previous annual statement.

Marseilles (Ill.) Companies Purchased.—The Illinois Traction System has purchased the Marseilles Water & Light Company and the Marseilles Land & Water Power Company, of Marseilles, Ill., and will operate these properties.

Financial.

The Week in Wall Street.

EVERYTHING in Wall Street was in an uncertain and almost demoralized condition last week. Trading was generally light; the rumor mongers were working overtime and prices were extremely sensitive. When the news came out that the conference between the railroad presidents and the President had resulted in a withdrawal of the government injunction suit and an agreement on the part of the railroads to suspend the rate advances until the new railroad bill was passed, the stock market advanced as violently as it had declined the week previous. Later in the week when it was found that the agreement between the railroads and the government had settled nothing and only furnished delay prices sagged again and conditions were unsettled. There were few outsiders represented in the trading and no investment buying and it looked to many observers like an old-time fight between the bulls and bears who were fairly evenly divided. One of the many rumors was to the effect that the Standard Oil following was committed to the bear side while the Morgan forces were vigorously working for higher prices. It is fairly well understood that in the sharp break which occurred two weeks ago many weakly margined speculators were shaken out—this being especially true with dealers in Steel common. Such a shakedown has curtailed trading and made the banks more cautious about extending credit. When the break occurred the bears thought they had accomplished the demoralization they have so long sought, but prompt support was furnished both to Amalgamated and Steel and the decline was checked. As usual during periods of light trading the money market appears to be very easy. Quotations are unusually low and bank statements show an abundance of cash. The trouble is that only the insiders can borrow, and many who would like to buy at bargain prices are unable to do so. Quotations June 13 were: Call, 2¼@3 per cent; 90 days, 3½ per cent. The quotations in the table are those of the close, June 13.

NEW YORK.

	June 6.	June 13.	Shares sold.		June 6.	June 13.	Shares sold.
All.-Ch.	8¼	9*	600	Int.-Met., pfd.	48½	51	22,000
All.-Ch., pfd.	32	30*	300	Mackay Cos.	85	88	600
Amal. Cop.	64	63¼	313,900	Mackay C., p.	76*	76*	200
Am. D. T.	20½*	20½*	—	Man. Elev.	132	130*	572
Am. Loc.	41	43	6,300	Met. St. Ry.	15*	15*	—
Am. Loc., pfd.	106	105¼	35	N.Y.&N.J.Tel.	139¼*	139¼*	—
Am. Tel. & C.	75*	75*	—	Steel, com.	75⅞	77¾	1,053,213
Am. T. & T.	132	134⅞	11,015	Steel, pfd.	114½	115½	22,037
B. R. T.	76	77¾	40,695	W. U. T.	62¼	63	4,100
Gen. Elec.	140	144½	4,855	West'h., com.	59	59¾	4,500
Int.-Met.	17½	18⅞	15,190	West'h., pfd.	111*	111*	—

PHILADELPHIA.

	June 6.	June 13.		June 6.	June 13.
Am. Rys.	44	44*	Phila. Elec.	14½	15
Elec. Co. of A.	11⅝*	11½	Phila. R. T.	17⅞	19
Elec. St. B'ty.	56¾	54¾	Phila. Trac.	85	84*
E. S. B'ty, pfd.	30*	30*	Union Trac.	46½	46¼*

CHICAGO.

	June 6.	June 13.		June 6.	June 13.
Chi. City Ry.	180*	180*	Chi. Tel. Co.	118	119
Chi. Rs., Ser. 1.	77*	75*	Met. El., com.	21¼	21½*
Chi. Rs., Ser. 2.	18	18½	Met. El., pfd.	62	63*
Com. Edison.	112½	114½	Nat'l Carbon.	108*	114¼
Chi. Subways.	2½	2½*	Nat'l Car., pfd.	119	119*

BOSTON.

	June 6.	June 13.		June 6.	June 13.
Am. T. & T.	132⅛	134⅞	Mex. Tel.	5	6*
Cum. Tel.	145*	145*	Mex. Tel. pfd.	6½*	6¼
Edison E., Ill.	248	248	N. E. Tel.	133½	134½
Gen. Elec.	141	143¾*	W. T. & T.	15¾	15¾*
Mass. E. Ry.	16½	16½	W. T. & T., pfd.	86	86*
Mass. E. Ry., pfd.	81	80			

* Last price quoted.
Shares sold for week of June 6 to June 11.

Financial Notes.

Chicago Traction Consolidation.—The conferences which were held in New York last week between representatives of the Chicago Railways Company and the bondholders of the Chicago Consolidated Traction Company were adjourned to Chicago where they were resumed June 14. It is understood that some of the interests have already assented to a proposition which has been made with a view to adjusting all the grievances of the bondholders. This proposition, it is said, involves the taking over, free and clear, by the Chicago Railways Company of the Consolidated Traction Company, and of issuing new securities in payment for the claims against the Railways company which have been set up by the bondholders. The essential features of the plan are that the bondholders will accept a 4 per cent income bond of the Railways company equivalent in face value to one-half of the 4 per cent bonds of the Consolidated Traction Company, involved in the present negotiations. A considerable number of the holders of the old bonds have already agreed to this plan, the largest single holder being the Yerkes estate. There are outstanding and involved in this controversy $6,500,000 4 per cent bonds of the Consolidated Traction Company. By cutting down this amount one-half, the additional interest charge imposed upon the Chicago Railways Company will be but a little more than $100,000 a year, which it is claimed, will not be at all oppressive. The Railways company will rehabilitate and operate the 185 miles of track belonging to the Traction company. If this plan goes through, the receiverships of both of the companies will be lifted as soon as the legal requirements can be met by both parties to the deal. The plan also takes up the outstanding bonds of the Evanston Electric Railway, the Cicero & Proviso Street Railway and the Ogden Street Railway Companies. Purchase money bonds and rehabilitation bonds will also be issued under the plan.

Doherty in Big Irrigation Project.—The Denver Reservoir & Irrigation Company, one of the largest irrigation propositions in Colorado, was last week placed in the hands of a receiver upon application made by the president of the company, Joseph Standley. Frederick W. Taylor, of Denver, was named as receiver, and was authorized to issue $250,000 of receiver's certificates to carry on the work. The charge in the petition asking for the receivership was that the Trowbridge & Niver Company, of Chicago, the bankers who were financing the project, had not carried out its contract. It is now said that Henry L. Doherty, of H. L. Doherty & Company, 60 Wall Street, New York, has undertaken to finance the company, and has agreed to raise $2,000,000 for the immediate needs of the development, and that the property will within a few days be taken out of the hands of the receiver and placed under Mr. Doherty's charge. Mr. Doherty was in Chicago last week completing the details of this deal. Through the efforts of Mr. Doherty several other irrigation projects will be combined with the Denver Reservoir & Irrigation Company, and enough money will be raised to complete the work. Under the new deal the property of the company, consisting of reservoirs and water rights covering 120,000 acres, will be turned over to the Doherty syndicate, and to these will be added about 400,000 acres in the valley of the Arkansas River. Development work will be pushed rapidly forward as soon as the new interests take charge. Mr. Doherty's efforts will also relieve the Trowbridge & Niver Company of its present embarrassment.

Western Electric Company.—The Western Electric Company has filed with the Chicago stock exchange a complete report of its financial condition as of March 1, 1910, in connection with the listing of $8,750,000 of 5 per cent bonds. The report shows that gross sales of the company for its fiscal year which ended Nov. 30, 1909, were an increase of $13,261,638 over the previous year. It also shows current assets on March 1 of $39,168,000, which is $4,726,000 more than the total capital and current liabilities. The business of the company is reported as increasing every month.

Niagara Power Company Merger.—A certificate has been filed with the Secretary of State at Albany announcing that the Hydraulic Power Company of Niagara Falls had been merged with the Niagara Falls Hydraulic Power & Manufacturing Company, a subsidiary concern of which it owned the entire capital stock. As announced in the issue of June 9, the Hydraulic Power Company has just increased its capital stock from $500,000 to $12,000,000. The property is largely owned by the Schoellkopf family of Niagara Falls. The company sells not only electrical energy, but also water power.

Westinghouse Back Dividends.—It is stated that when the directors of the Westinghouse Electric & Manufacturing Company meet next week they will pass a resolution ordering paid the accumulated and over due dividends on the preferred stock. The amount of these unpaid dividends now outstanding is 8¾ per cent. At the office of the Westinghouse company no confirmation of this report would be given.

Gary & Interurban Electric Railway.—It is reported from Chicago that interests identified with the City Railway Company have made a bid of $500,000 for the property of the Gary & Interurban Electric Railway. The road has ten miles of track and connects Gary and Hammond, Ind.

Norfolk & Portsmouth Traction Company.—The new financial plan of the Norfolk & Portsmouth Traction Company has been declared operative, and calls have been issued for deposits of the stock in the Trust Company of North America, New York. The plan authorizes the calling in of the $800,000 convertible notes which are due March 1, 1911 and March 1, 1912. It also provides for the entire discharge of all the floating indebtedness of the company. No new securities will be issued and the capitalization will remain the same, the only change being that instead of the present issue of $6,000,000 of common stock there will be an issue of $3,000,000 of 5 per cent cumulative preferred, and $3,000,000 of common. It is estimated that the total cash which will be raised under the plan will be $1,800,000, which, after paying the outstanding indebtedness of the company, will leave $550,000 for improvements and extensions.

Kellogg Switchboard & Supply Company.—Hill, Small & Company, bankers of Chicago, are offering to the public a limited amount of the common stock of the Kellogg Switchboard & Supply Company. This stock is being offered at $170 per share, and in the announcement of the bankers it is claimed that it has an actual book value of $225 per share. Two quarterly dividends of 2 per cent each have been paid upon the stock since the first of the year. At a meeting of the directors in January a stock dividend of 100 per cent was declared and the capital of the company was increased from $500,000 to $1,000,000.

Third Avenue Railway Company.—It has been announced that Edward A. Maher will be made president of the newly organized Third Avenue Railway Company. This is the company which has been organized by the bondholders committee which bid in the property of the Third Avenue Railroad Company at foreclosure sale. Mr. Maher has been general manager of the Third Avenue Railroad Company under Receiver Whitridge. Before the property went into the hands of a receiver, he was the president of the Union Railway Company, which was the subsidiary organization of the Third Avenue Railroad Company owning and operating the lines in the Bronx.

Continental Telephone Receivership.—The proceedings for the appointment of receivers for the Continental Telephone & Telegraph Company, which were begun two weeks ago in Trenton, have been dropped. An agreement was reached between the stockholders who brought the suit and the officers of the company, and the application which alleged mismanagement has been withdrawn. It is said that the proceedings were begun through a misunderstanding. The Continental company is the $50,000,000 concern which was organized to consolidate Independent telephone companies.

Shawinigan Water & Power Company.—A meeting has been called of the shareholders of the Shawinigan Water and Power Company, of Montreal, for July 8, for the purpose of voting upon the proposed increase in the capitalization of the company. The plan is to authorize an increase of common stock from $7,000,000 to $10,000,000 and also to issue debenture stock to an amount not exceeding $500,000. There is now outstanding $3,000,000 debenture mortgage stock and $4,900,000 mortgage bonds.

Westinghouse Company Sells Notes.—The Westinghouse Electric & Manufacturing Company has sold to Kuhn, Loeb & Company $4,000,000 of three-year, 6 per cent notes. The proceeds of this sale will be used to refund the $6,000,000 issue of 6 per cent notes which fall due in August. The new notes are being offered for subscription at par. The extra $2,000,000 for taking up the old issue has been provided for out of the earnings of the company.

Sanitary District of Chicago.—The earnings of the electrical department of the Sanitary District of Chicago for the year 1909 were gross $391,936, net $208,484. The surplus to the credit of this department at the end of the year was $63,211.

DIVIDENDS.

American Locomotive Company, preferred, quarterly, 1¾ per cent, payable July 21.

Butte Electric & Power Company, quarterly, preferred 1¼ per cent, payable Aug. 1; common 1¾ per cent, payable July 1.

Canadian Westinghouse Company, Ltd., quarterly, 1½ per cent, payable July 11.

Chattanooga Railway & Lighting Company quarterly, preferred, 1½ per cent, payable July 1.

Cumberland Telephone & Telegraph Company, quarterly, 2 per cent, payable July 1.

Hudson Terminal Company, semi-annual, 3 per cent, payable July 1.

Lindsay Light Company, quarterly, 5 per cent, payable July 1.

Manhattan Elevated Railway Company, quarterly, 1¾ per cent, payable July 1.

New England Lighting Company, quarterly, preferred, 1½ per cent, extra 4 per cent; common, 1½ per cent, extra, 4 per cent, all payable June 27.

Otis Elevator Company, preferred, quarterly, 1½ per cent, payable July 1.

Phelps, Dodge & Company, quarterly, 2½ per cent, payable June 29.

Philadelphia Company of Pittsburgh, quarterly common, 1½ per cent, payable Aug. 2; extra ½ per cent, payable Aug. 2; extra ½ per cent, payable Nov. 1.

Puget Sound Electric Railway Company, semi-annual, preferred, 3 per cent, payable July 1.

Reading Traction Company, semi-annual, 1½ per cent, payable July 1.

St. Joseph Railway, Lighting, Heat & Power Company, preferred, quarterly, 1¼ per cent, payable July 1.

Seattle Electric Company, quarterly, 1¾ per cent, payable July 15.

Toronto Railway Company, quarterly, 1¾ per cent, payable July 2.

United Gas Improvement Company, quarterly, 2 per cent, payable July 15.

United Traction & Electric Company of New Jersey, quarterly, 1¼ per cent, payable July 1.

Western Union Telegraph Company, quarterly, ¾ per cent, payable July 15.

West Penn Traction Company, quarterly, preferred, 1½ per cent, payable July 1.

Wilkes Barre Gas & Electric Company, quarterly, 1¼ per cent, payable July 1.

REPORTS OF EARNINGS.

	Gross earnings.	Expenses.	Net earnings.	Charges.	Surplus.
American Telephone & Telegraph Company:					
April, 1910	$13,794,283	$5,002,013	$4,210,146	$959,405	$3,250,741
April, 1909	12,370,382	4,471,955	4,179,720	892,456	3,287,146
Chicago City Railway Company:					
Quarter ended April 30, 1910	2,311,854	1,603,218	708,636	.....	.....
Quarter ended April 30, 1909	2,174,565	1,507,055	667,510	.....	.....
Cumberland Telephone & Telegraph Company:					
April, 1910	565,054	369,969	195,085	.....	.....
April, 1909	531,886	341,704	190,182	.....	.....
Edison Electric Illuminating Company, of Boston:					
May, 1910	362,412	167,974	194,438	.....	.....
May, 1909	296,830	148,781	148,049	.....	.....
Mexican Telephone & Telegraph Company:					
Year ended Feb. 28, 1910	480,609	229,592	251,017	.....	.....
Year ended Feb. 28, 1909	385,767	204,331	181,436	.....	.....
Portland Railway, Light & Power Company:					
May, 1910	466,436	177,109	289,327	152,969	136,358
May, 1909	399,590	157,921	241,669	145,027	96,642
St. Joseph (Mo.) Railway, Light, Heat & Power Company:					
May, 1910	79,587	45,276	34,311	22,683	11,628
May, 1909	77,187	42,622	34,565	21,536	13,029
United Railways of San Francisco:					
April, 1910	648,015	366,430	281,585	.....	.....
April, 1909	620,625	345,530	275,096	.....	.....
Western Union Telegraph Company:					
Quarter ended June 30, 1910	.....	.....	†1,950,000	433,062	1,516,937
Quarter ended June 30, 1909	.....	.....	1,867,194	433,062	1,434,132
Westinghouse Electric & Manufacturing Company:					
Year ended March 31, 1910	.....	.....	†4,700,000	2,284,288	2,415,712
Year ended March 31, 1909	.....	.....	1,966,259	2,200,771	*234,512

† Estimated. * Deficit.

General News

Construction News.

ALICEVILLE, ALA.—The construction of an electric light system in Aliceville is under consideration, work on which, it is reported, will begin in the near future.

JACKSON, ALA.—The Bigbee Ice & Development Company is reported to have increased its capital stock from $15,000 to $25,000. The company proposes to install an electric light plant.

BISBEE, ARIZ.—The Copper Queen Consolidated & Mining Company, of Bisbee, Ariz., is reported to be contemplating the installation of a large electric driven air compressor in its power plant.

JONESBORO, ARK.—Extensive additions and improvements are contemplated by the Home Telephone Company, for which bonds to the amount of $30,000 will be issued.

ALAMEDA, CAL.—It is reported that bids will be received in the near future for supplying electricity for the day service of the municipal electric light plant. The minimum amount to be contracted for will be 175 kw. It is estimated that the necessary apparatus to equip the municipal plant for the service will cost about $15,000.

LOS ANGELES, CAL.—Plans have been prepared by the Los Angeles Gas & Electric Corporation for an addition to its power station on South Alameda Street, to cost about $12,000. The new building will be used as a boiler-room and generating plant.

OROVILLE, CAL.—The Oro Water, Light & Power Company is contemplating the construction of a large power plant at the mouth of Yellow Creek. It is proposed to build a large ditch to the bluff on the Feather River, near the mouth of Yellow Creek, where a fall of over 1900 ft. can be secured.

RED BLUFF, CAL.—Notices of appropriation of two water rights have been filed calling for a total of 17,000 cu. in. A. D. Cutler has appropriated 5000 cu. in. on the Sacramento River, near Kirkwood, to be used for irrigating purposes. Application has also been made by W. F. Luning for 12,000 cu. in. on Mill Creek, 20 miles from the river, south of Champion, the water to be utilized to generate electricity.

REDDING, CAL.—Announcement has been made by the Northern California Power Company that work will commence at once on the construction of its Coleman plant. Contracts have been placed with the Allis-Chalmers Company, of Milwaukee, Wis., for hydraulic turbines, and all the electrical machinery and equipment for the plant, consisting of three 700-hp, single horizontal turbines; three 5000-kw generators and two 250-hp, single-phase exciter turbines. The turbo-generators will operate under a head of 480 ft., from two pipe lines 3400 ft. long and 6 ft. in diameter. The voltage will be stepped up from 6600 volts to 66,000 volts. The four plants of the company in the different Battle Creek sections are all interconnected with the present transmission line in Chico. Another line is being erected from Coleman, on the south side of the Sacramento River, to Hamilton City, where it will connect with a branch line from Hamilton with Chico, at Nord.

RICHMOND, CAL.—The Richmond Light & Power Company has been reorganized under the name of the Richmond Light & Power Corporation with a capital stock of $2,500,000. The company proposes to extend and enlarge its plant and service. The incorporators of the new company are: Sidney F. T. Brock, of Philadelphia, Pa.; J. S. Lamson, of San Francisco, Cal.; Allen L. Chickering, of Oakland, Cal., and Evan Williams, of San Francisco, Cal.

STOCKTON, CAL.—The Central California Traction Company, of San Francisco, Cal., has applied to the Board of Supervisors for a 50-year franchise to construct and operate an electric railway over certain streets and highways in San Joaquin County. Samuel B. McLenegan, of Stockton, Cal., is general manager.

WHITTIER, CAL.—The Board of Trustees is reported to have decided to engage an engineer to prepare plans for the installation of plants to supply both gas and electricity.

CENTRAL CITY, COL.—The Golden Sun Mining & Milling Company is reported to be preparing plans for the construction of a concentrating plant and mill, which will be equipped for electric motor drive.

DENVER, COL.—The directors of the Northern Colorado Power Company have authorized the erection of a new transmission line between Lafayette and Greeley, at a cost of $250,000, and also inaugurated plans for other extensive improvements. The new transmission line is to take in Fort Lupton, Brighton, and all the towns along the Union Pacific Railroad. A line is now being erected from Evans in this direction and is to be continued on toward the power plant along the route of the Denver, Laramie & Northwestern Railway.

PUEBLO, COL.—We are informed that the Pueblo & Suburban Traction & Lighting Company is contemplating a number of improvements this year, including the installation of new coal and ash-handling apparatus, new pumps, condensers, cooling towers, boilers, stokers, etc. T. C. Roberts is superintendent of power plant and shops.

EAST NORWALK, CONN.—The citizens have voted to appropriate $2,000 to enlarge the municipal electric light plant. It is proposed to install a 37½-kw generator and a 25-hp motor.

WATERBURY, CONN.—Westinghouse, Church, Kerr & Company have been engaged as engineers in connection with the power plant of the Connecticut Company, the contract for construction of which has been awarded to Fred T. Ley & Company, of Springfield, Masss.

WASHINGTON, D. C.—The Arcade Company of Washington is in the market for equipment for a small electric plant, including steam boilers, generators, etc. The contract for refrigerating machinery has been awarded to the Frick Company, of Waynesboro, Pa. Averill & Adams, 718 Union Trust Building, Washington, D. C., are architects.

WASHINGTON, D. C.—Bids will be received at the Bureau of Supplies and Accounts, Navy Department, Washington, D. C., until June 28 as follows: Puget Sound, Wash., Schedule 2566—two motor-driven centrifugal drainage pumps. Brooklyn, N. Y., Schedule 2577—12 sets of wireless telegraph apparatus. Hingham, Mass., Schedule 2578—A standard gauge compressed-air locomotive, an accumulator, and supplying, installing and testing outside pipe lines and changing stations. Application for proposals should designate the schedules desired by number.

DUNNELLON, FLA.—The city is reported to be contemplating the rebuilding of the municipal electric plant. It is proposed to equip the plant to furnish energy for electric lamps and water works system.

JACKSONVILLE, FLA.—Contracts have been awarded by the Board of Bond Trustees for machinery for the municipal electric light plant as follows: To the Allis-Chalmers Company, of Milwaukee, Wis., for one 1500-kw turbo-generator at $24,480; for condenser equipment, to the C. H. Wheeler Manufacturing Company, of Philadelphia, Pa., for $10,975, and for motor-generator set to the Fort Wayne Electric Works, of Fort Wayne, Ind., for $9,760.

ALBANY, GA.—Work has commenced on the construction of the steam auxiliary power plant of the Albany Power & Manufacturing Company. The Gallivan Construction Company, of Greenville, S. C., has the contract for construction of same.

CANTON, GA.—The entire property and franchises of the Etowah Power Company in Cherokee County were sold at public auction on June 8 to E. R. Ashley and S. E. Smith for $160,000. It is understood that the property was purchased for the Georgia Power Company. W. A. Carlisle was receiver.

COLLEGE PARK, GA.—The City Council is reported to have engaged the Solomon-Norcross Company, of Atlanta, Ga., to take charge of the engineering work in connection with the construction of the proposed electric light plant and water-works system. The cost of the electric light plant is estimated at $15,000.

MILLEDGEVILLE, GA.—The Milledgeville Telephone Company is making preparations to enlarge and rebuild its telephone system. J. T. King is manager.

OLIVER, GA.—It is reported that the Ogeechee River will be developed just below Halcyondale, Ga., to generate electricity, which will be transmitted to Oliver. The cost of the project is estimated at about $1,000,000.

RAYMOND, GA.—The Raymond Oil & Gin Company is reported to be in the market for a 50-lamp generator. S. T. Blalock, of Raymond, Ga., is president.

WRIGHTSVILLE, GA.—It is reported that the city is contemplating the removal of the municipal electric plant from the present location to a new site in the city, for which bids will be probably asked for in the near future. Arthur Pew, Temple Court, Atlanta, Ga., is consulting engineer.

GRANGEVILLE, IDAHO.—The Big Bend Electric Light & Power Company, which recently purchased the plant of the Grangeville Light & Power Company, will take possession June 1. Announcement has been made that the new company will make extensive improvements and extensions to the plant within 90 days, which will involve an expenditure of about $50,000. The service will also be extended to Cottonwood. Eugene Enloe, of Spokane, Wash., will be manager.

LIMON, IDAHO.—Plans are being prepared for the construction of an electric light plant and water works system in Limon, Col., to cost about $65,000. Burns & McDonnell, Scarritt Building, Kansas City, Mo., are consulting engineers.

FREEPORT, ILL.—The Stephenson County Light & Power Company is reported to be considering a bond issue for the construction of a power plant.

OBLONG, ILL.—The Oil Belt Traction Company has awarded the contract for the construction of its proposed 12-mile railway between Bridgeport and Oblong, Ill., to McCann Brothers, of Murphysboro, Ill. N. L. Upson is manager.

STREATOR, ILL.—The Economy Light & Power Company, of Joliet, Ill., has been granted a 50-year franchise to supply electricity for lamps

and motors and gas in Streator. The company has purchased the local plant.

BEDFORD, IND.—Horace Stillwell, of Anderson, Ind., and Stoughton A. Fletcher, of Indianapolis, Ind., are interested in a project to construct a large dam on the White River. The cost of the proposed work, including dam, power house equipment, etc., is estimated at $500,000. Electricity generated at the plant will be utilized for lamps and motors in the Bedford quarries and in towns and villages within a radius of 20 miles.

COLUMBUS, IND.—The Commissioners of Bartholomew County have granted the Columbus Gas & Light Company, of Columbus, Ind., a franchise in East Columbus.

COLUMBUS, IND.—The directors of the Citizens' Telephone Company have decided to make extensive improvements to its system, including the installation of a new exchange, at a cost of about $50,000.

CRAWFORDSVILLE, IND.—We are informed that bids will be received in about three weeks for the construction of the proposed new municipal electric light plant, to cost about $100,000. The Esterline Company, of West La Fayette, Ind., has charge of construction of the plant.

DUNKIRK, IND.—The plant and holdings of the Dunkirk Lighting Company have been purchased by the American Gas & Electric Company, of New York, N. Y. It is understood that the Dunkirk plant will be closed down and electricity for operating the system will be furnished from the Muncie plant. A high-tension transmission line will be erected from Muncie to Dunkirk, and it is expected that the service will be extended from the Dunkirk station to Redley and other places in that vicinity.

HARTFORD CITY, IND.—The American Gas & Electric Company, of New York, N. Y., which recently purchased the property of the Hartford City Lighting Company, will assume management of the plant at once. The company will soon commence work on the reconstruction of its plant, as agreed under the terms of the purchase, by which the company is to expend $25,000 within one year.

INDIANAPOLIS, IND.—Plans are being considered by the People's Light & Heat Company to duplicate the equipment of its plant. A large centrifugal pump will be installed to increase the hot water service. The four smoke stacks will be replaced by one large one 200 ft. high; modern smoke consuming devices and coal conveying machinery will be installed and some electrical equipment added. The cost of the work is estimated at $65,000.

LOGANSPORT, IND.—The merchants of Logansport have decided to install an ornamental system of electric street lamps on Market, Third and Fourth Streets. It is proposed to erect arches across the streets. The merchants will purchase and erect the system and maintain the same. They offered to purchase a plant at $7,500 and donate it to the city provided the city would maintain it. The offer was refused.

NEW BELLESVILLE, IND.—The capital stock of the Pike's Peak Telephone Company has been increased from $2,000 to $10,000. W. S. Cook is president.

NEW CASTLE, IND.—Preparations are being made by the New Castle Independent Telephone Company for improvements and extensions to its property, which will involve an expenditure of about $65,000.

NEW MARKET, IND.—The New Market Light Company, recently incorporated, proposes to install a plant to furnish electricity for lamps, heat and motors in New Market and vicinity. The directors are: W. V. Yount, N. J. Mills, L. B. Elter and Alberti Hinipierer.

RICHMOND, IND.—The County Commissioners of Wayne County on June 8 regranted the franchise to Robert S. Ashe without changing any of its provisions, which was recently rescinded by the Commissioners. Mr. Ashe was granted a franchise to erect transmission lines over all the turnpikes in Wayne County, for which no compensation was asked, to supply electricity for lamps and motors to small villages and farmers along the lines. The people of Richmond objected to the free grant, but the people in the rural districts wished the service and urged the commission to grant the franchise.

SOUTH BEND, IND.—Plans are being considered for the installation of ornamental street lamps on the principal business streets in South Bend. The system will be installed by the Indiana & Michigan Electric Company.

ALBIA, IA.—The stockholders of the Albia Interurban Railway Company are reported to have voted to issue $300,000 in bonds, the proceeds to be used for the extension of its system to Buxtom, a distance of 12 miles. The contract for the work has been awarded to the Engineering Construction & Securities Company, of Chicago, Ill.

DES MOINES, IA.—The construction of an interurban railway from Des Moines to Iowa City, via Williamsburg and Montezuma, is contemplated. Rheines & Chamberlain are reported to be interested in the project.

IOWA CITY, IA.—The Iowa City Electric Railway Company was recently organized to construct an electric railway to Runnell's addition this summer and another to the city park. The company is capitalized at $100,000. J. O. Schulze is president of the company and D. A. Reese, secretary and treasurer.

LOWELL, IA.—The construction of a hydroelectric power plant in Lowell is reported to be under consideration. Messrs. Pitcher, Whiting and Crane are interested in the project.

MONTICELLO, IA.—A special election will soon be held to vote on the proposition to extend the franchise of the Monticello Electric Light & Power Company, which will expire November, 1911. The company wishes to have its franchise renewed at this time so that it may proceed with its proposed improvements.

BAXTER SPRINGS, KAN.—Preparations are being made by the Oklahoma & Kansas Railway Company for the survey of its proposed electric railway, which will connect Columbus and Galena, Kan., with Baxter Springs, where it will then extend south through Sunny Side, Lincolnville and Hattanville, Okla., thence to Miami, Okla. The W. K. Palmer Company, of Kansas City, Mo., has been engaged as consulting engineer.

CHANUTE, KAN.—The Atchison, Topeka & Santa Fe Railroad Company, it is said, is considering the installation of a large water supply station in Chanute, to be equipped with electric motor-driven pumps.

BOWLING GREEN, KY.—A company is reported to have been organized for the purpose of constructing electric light and ice plants in Bowling Green. T. W. Jenkins and J. W. Bearce are interested in the project.

CLEAR LAKE, LA.—The Western Electric Telephone Company, which recently purchased the controlling interest in the Clear Lake Independent Telephone Company, is planning to make extensive improvements to the system, work on which will commence in the near future.

AUGUSTA, MAINE.—The Edwards Manufacturing Company is constructing a substation at its plant in this city, which will be used as an auxiliary to its water-power. The new station will have a rating of about 800 hp.

ISLAND FALLS, MAINE.—The Katahdin Farmers' Telephone Company has applied to the County Commissioners for permission to erect telephone lines along the highways in certain unorganized townships in Penobscot County. Carl E. Milliken is president of the company.

ALBERTON, MD.—The Gary Manufacturing Company has awarded the contract for the construction of a dam 30 ft. high and 300 ft. long across the Patapsco River, to the Ambursen Hydraulic Construction Company, 176 Federal Street, Boston, Mass. Wehr, Walden & Dukehart, 412 Continental Building, Baltimore, Md., are the engineers.

BALTIMORE, MD.—The United Railways & Electric Company has decided to extend its Edmundson Avenue line to Orangeville, plans for which have been prepared. William A. House is president of the company.

BALTIMORE, MD.—The contract for electrical and mechanical equipment for the sewage disposal works, bids for which were opened May 11, 1910, has been awarded to the McCay Engineering Company, of Baltimore, Md., for $42,440. Calvin G. Hendrick is chief engineer of Sewerage Commission.

HAGERSTOWN, MD.—A movement is on foot to extend the Hagerstown Railway Company's system from Williamsport to Winchester, via Hedgesville.

ATHOL, MASS.—Plans are being prepared by the L. S. Starrett Company to extend its transmission lines to the shops of the Athol Machine Company to supply electricity to operate the shops of the company. It is estimated that the installation of electricity in the shops will result in a saving of several thousand dollars a year.

BOSTON, MASS.—A plan has been presented to the school house commission by Chairman Sturgis to erect a building for an independent boiler plant and power house for heating and lighting the Cushman, Eliot, Hancock, Christopher, Columbus and Hancock Annex school houses in the North End, at an estimated cost of $83,300. George E. Brock and James P. Magenis, of the school board, were appointed to act with the commissioners in looking into the matter.

SOMERVILLE, MASS.—The Board of Aldermen is considering the question of establishing an electric generating plant in the Latin School to supply electricity to light the different municipal buildings on Central Hill. It is estimated that a generator can be installed for about $5,000 and the plant operated at a cost of about $2,000 per year. It now costs the city more than $5,000 per year to light the buildings.

WATERTOWN, MASS.—The Hood Rubber Company has entered into a contract with the Edison Electric Illuminating Company, under which the Edison Company will supply electricity for operating the plant of the Hood Rubber Company. The large steam engines will be abandoned and the plant equipped for electric motor drive. About 2500 hp will be required.

DETROIT, MICH.—The Everitt, Metzger, Flanders Company is reported to be making preparations for the erection of an addition to its plant, which will double its present capacity. Some electrical apparatus it is understood, will be required.

DETROIT, MICH.—Arrangements have been made by the Northway Motor Company, of Detroit, Mich., for the installation of three transformers with a rating of 900 kw for the purpose of transforming the energy received from a central generating station for use in its plant.

DOWAGIAC, MICH.—The Dowagiac Railway Company is reported to have commenced work on the construction of an electric railway between Eau Claire and Dowagiac, 10 miles in length. H. C. Mann, of Benton Harbor, Mich., is general manager.

LUDINGTON, MICH.—Plans are being considered by the United Home Telephone Company, which will include the erection of about

22 miles of No. 10 copper toll lines and extensions to its city and rural lines.

BUFFALO, MINN.—The City Council is reported to be considering the construction of a new power station.

DULUTH, MINN.—The Minnesota Canal & Power Company, it is stated, is making preparations for the construction of a power plant between West Duluth and Birch Lake.

DULUTH, MINN.—Plans are being considered by the West End Commercial Club for the extension of the ornamental street lighting system along Superior Street, from Eighteenth to Twenty-second Avenue, the cost of which is estimated at $3,500.

DULUTH, MINN.—Plans are being prepared by the Zenith Telephone Company for extensive improvements to its system, which will involve an expenditure of about $200,000. A new exchange building will be erected on Twenty-first Avenue, West, at a cost of $10,000.

GRAND RAPIDS, MINN.—The municipal authorities are considering a large hydraulic development to supplement or replace the present municipal power plant.

HIBBING, MINN.—The Shenango Furnace Company has placed an order with the Allis-Chalmers Company, of Milwaukee, Wis., for a 14 x 24 "Reliance" type, heavy duty, Corliss engine direct connected to a 100-kw. 240-volt, 150 r. p. m., direct-current generator. This is a duplicate of the unit recently installed at Lucknow Siding, Minn., for the furnace company.

MAZEPPA, MINN.—We are informed that the village is developing additional water power in connection with the municipal electric light plant and expects to install a larger generator.

MINNEAPOLIS, MINN.—The Twin City Rapid Transit Company is reported to be considering plans for the construction of a direct line to Stillwater. W. J. Hield, of Minneapolis, Minn., is general manager.

SHERBURN, MINN.—The question of establishing an electric light plant in Sherburn is reported to be under consideration. It is understood that the proposition will soon be submitted to a vote.

AMORY, MISS.—The city is reported to be contemplating the purchase of the local electric light plant, for which $18,000 in bonds will be issued. J. M. May is city clerk.

DEXTER, MO.—It is reported that the municipal electric light plant, which is now operated under lease, will be enlarged and improved.

KANSAS CITY, MO.—The Helmers Manufacturing Company, of Kansas City, Mo., is reported to have placed orders with the Wagner Electric Company, of St. Louis, Mo., for a large line of alternating-current motors to operate the machinery in its shops.

KANSAS CITY, MO.—Application has been made to the City Council by the Intercity Viaduct Railway Company for a 30-year franchise to operate a system of modern electric freight railway terminals on the north side of the city, which will connect with every railroad system entering both Kansas Citys. The cost of the system is estimated at $1,500,000.

KIRKSVILLE, MO.—The capital stock of the Kirksville Light, Power & Ice Company has been increased from $13,000 to $66,000.

MALDEN, MO.—Plans are being considered for the construction of an electric light plant and water works in Malden, bids for construction of which will be called for in the near future. The cost of the work is estimated at $30,000. Archer Roehm & Company, of Malden, Mo., are engineers.

SLATER, MO.—At an election held recently the citizens voted in favor of the proposition to issue $27,500 in bonds, the proceeds to be used to rebuild the electric light and water-works plant. It is also proposed to extend the transmission lines. Burns & McDonnell, Scarritt Building, Kansas City, Mo., are engineers.

HAMILTON, MONT.—The local electric light and water plants are reported to have been purchased by W. A. Clark, who, it is said, will make extensive improvements to the electric plant at once.

HAVRE, MONT.—The Northern Montana Telephone Company, recently incorporated, proposes to construct several telephone lines in northern Montana, including one from Havre east to the Dakota line; from Havre to Benton, and another from Havre to Shelby, and other lines to Chester and the Marias River. The company is capitalized at $25,000, and the incorporators are: W. C. Broadwater, J. S. Carnal, W. H. Blair and D. S. McKenzie, all of Havre, Mont.

BEATRICE, NEB.—It is reported that surveys are being made by D. D. Francis and W. D. Price, of Lincoln, Neb., engineers, for a power dam on the Blue River, 5 miles south of Beatrice, to cost about $80,000.

FREMONT, NEB.—The capital stock of the Farmers' Telephone Company of Dodge County has been increased from $20,000 to $25,000, the proceeds to be used for extensions and improvements to its system.

OMAHA, NEB.—Extensive improvements are being made by the Omaha & Council Bluffs Street Railway Company to its power house, including the installation of fuel economizers, which are being installed by the Green Fuel Economizer. Orders have been placed with the Allis-Chalmers Company, of Milwaukee, Wis., for two 18 x 36, heavy, non-condensing Corliss engines, which will be direct connected to fans which are used in the induced draft system.

YERINGTON, NEV.—Extensive improvements are contemplated to the property of the Nevada-Douglass Company, which will include the installation of a new compressor plant, the construction of a transformer station and the erection of an electric transmission line to the Ludwig mine.

ATLANTIC CITY, N. J.—The Atlantic City & Shore Railroad Company has closed down its power station on New York Avenue, and has entered into a contract with the West Jersey Shore Railroad Company to furnish electricity to operate its cars in Atlantic City.

JERSEY CITY, N. J.—The Street and Water Board has introduced and given a first reading an ordinance permitting the Hudson-Middlesex Telephone Company permission to lay its proposed conduits through Jersey City to connect the lines in Essex County with New York, N. Y.

BUFFALO, N. Y.—The J. W. Pohlman Foundry Company, of Buffalo, N. Y., is reported to have purchased the plant located at Baitz Avenue and the Erie Railroad, which it proposes to enlarge and equip for its business, which will be removed from the present plant. Considerable new machinery will be installed. The plant, it is understood, will be equipped for electric motor drive. Electricity for operating the plant will be secured from Niagara Falls. J. W. Pohlman is president of the company.

GENEVA, N. Y.—The Geneva-Seneca Electric Company has been authorized by the Public Service Commission, Second District, to execute a mortgage to secure bonds to the amount of $750,000 instead of $500,000, as it is believed that the company will be required to expend a larger amount of money than was heretofore contemplated by reason of the purchase of the property, rights and franchises of the Economic Power & Construction Company.

GENEVA, N. Y.—The Public Service Commission, Second District, has granted the application of the Economic Power & Construction Company to transfer its franchises, system and property to the Geneva-Seneca Electric Company, under the following named conditions: That the Geneva-Seneca Electric Company shall at any time within 30 days, if request is made by the city of Geneva, enter into a contract with the city for the rental of two ducts or conduits for carrying of electric wires in each of the Exchange, Seneca and Linden street subways for a term expiring March 31, at an annual rental of 5 cents per lineal duct-foot. In this connection, the application of the Economic Company for authority to exercise franchises granted by Geneva is denied. The Geneva-Seneca Company is authorized by the commission to issue bonds secured by an existing mortgage to an amount not exceeding $114,000, to be sold at not less than 90, and to use $103,000 of the proceeds for the purpose of purchasing the property of the Economic Company in Geneva.

GLOVERSVILLE, N. Y.—The Public Service Commission, Second District, has granted the Fulton County Gas & Electric Company permission to issue three-year, 6 per cent gold notes to the amount of $99,000, to be sold at par and accrued interest. The proceeds to be used for the construction of a transmission line from the power station of the Mohawk Hydro Electric Company, in Ephrata, to the station of the Fulton County Gas & Electric Company, in Gloversville.

NEW YORK, N. Y.—The contract for installing electric equipment in new Public School 77, Ridgewood Park, Borough of Queens, N. Y., has been awarded to T. Frederick Jackson, New York, N. Y., for $11,245, by C. B. J. Snyder, superintendent of school buildings.

NIAGARA FALLS, N. Y.—The Hydraulic Power Company, of Niagara Falls, has certified to the Secretary of State its consolidation with the Niagara Falls Hydraulic Power & Manufacturing Company. The first-named company owned all of the capital stock of the latter. George B. Matthews is president of the company and Paul A. Schoellkopff is secretary.

RED CREEK, N. Y.—The question of lighting the Village of Red Creek with electricity is under consideration. A proposition has been submitted relative to extending the transmission lines of the Wolcott Electric Light & Power Company eastward to this village. It is proposed to extend the lines of the Wolcott company to the town line of Sodus, and there connect with the system of the Sodus Gas & Electric Light Company, which is supplied with electricity by the Rochester Railway & Light Company. Webster, Ontario, Williamson and Sodus are now supplied from the Sodus system. The Village of Red Creek has already voted to install electric street lamps if the project is carried through. It is understood that if a sufficient number of residents agree to take electrical service the system will be extended before the end of the year.

TOMPKINSVILLE, N. Y.—The contract for furnishing four turbo-generators for use at the general lighthouse depot Tompkinsville, N. Y., has been awarded to the Kerr Turbine Company, of New York, N. Y., for $19,500.

UTICA, N. Y.—The Utica Home Telephone Company has been granted a franchise by the village of Vernon to extend its lines through Petersborough Street and operate an exchange in the village.

WILSON, N. Y.—The Public Service Commission, Second District, has authorized the Conant-Bryant Power Company to commence work on construction and exercise its franchise in the town of Wilson, and also authority to issue its capital stock to the amount of $25,000, the proceeds to be used for the purchase and installment of an electrical plant, including power house, equipment and transmission lines in the village.

CLINTON, N. C.—It is reported that the Sampson Power Company is in the market for second-hand electrical equipment, including a 75-kw. three-phase, 2300-volt generator, and automatic engine; also exciter and switchboard.

BEACH, N. D.—It is reported that the city is preparing to install a municipal electric light plant. A 40-ft. x 50-ft. power station will be erected of brick or concrete; the equipment will consist of a 150-hp compound engine, direct-connected to a three-phase, 60-cycle alternator and a 150-hp boiler; a deep-well pump and feed-water heater will also be installed. It is expected to have the plant completed by Sept. 1.

MERCER, N. D.—Halfdon Berg is reported to have purchased the local telephone exchange and proposes to establish lines out into the country.

CLEVELAND, OHIO.—The K. W. Ignition Company, of Cleveland, Ohio, is reported to be preparing plans for the construction of a new plant, for which a site has been secured on Chester Avenue, near East Thirteenth Street. It is understood that the company will be in the market for a gas engine, generator, etc.

RANDALL, OHIO.—The contract for the construction of a large power plant for operating ore handling machinery for the N. Y., P. & O. Dock Company, at Randall, has been awarded to F. C. Werk, electrical engineer and contractor, New England Building, Cleveland, Ohio. The building will be of fireproof construction, 115 ft. x 42 ft., with a brick stack 150 ft. in height. The equipment will include cross-compound, condensing engines, direct-current generators, water-tube boilers, heater, pumps and switchboard. The contract includes the drilling of wells and installing water softener plant and compressor plant. It is expected to have the plant completed by Sept. 15.

TOLEDO, OHIO.—The Toledo Railways & Light Company is considering the purchase of two 750-kw rotary converters.

YOUNGSTOWN, OHIO.—The street lighting committee has advised the City Council that it would be cheaper for the city to install and maintain a power plant for auxiliary street lighting than to accept the terms offered by the Youngstown Consolidated Gas & Electric Company. It states that the plant could be installed at the water-works station at a cost of about $25,000 and maintained at a cost of about $6,705 per year. Such a plant would supply electricity for 450 pedestals, while it is only proposed to erect 150 at the present time.

APACHE, OKLA.—Bids will be received by the town of Apache until June 27 for materials and equipment required for the construction of an electric light plant and water and sewer systems.

CHEROKEE, OKLA.—We are informed that bids will be received until June 3 by the city of Cherokee for construction of water works, electric lighting and sewer systems, the cost of which is estimated at about $65,000. Burns & McDonnell, Scarritt Building, Kansas City, Mo., are engineers.

HENRYETTA, OKLA.—The Henryetta Electric Light & Ice Company, recently organized, it is said, is planning to construct an electric light plant and ice factory in Henryetta.

OKLAHOMA CITY, OKLA.—Preparations are being made by the Oklahoma Railway Company for increasing the output of its power plant from 2800 to 7200 hp. It is undersood that contracts for equipment will be placed in the near future.

PORTLAND, ORE.—The Government Standard Power Company is reported to be contemplating the construction of a power plant, near Astoria, work on which is expected to commence in September.

PANAMA.—Bids will be received at the office of the general purchasing officer of the Panama Canal Commission, Washington, D. C., until June 24 for furnishing electrical material, including fixtures, fittings, arc lamps, carbons, fuses, cable, wire conduit tape, etc. Blanks and general information relating to circular No. 590 will be furnished on application to the above address, or at the office of the assistant purchasing agents, 24 State Street, New York, N. Y.; 55 National Realty Building, New Orleans, La., and 1086 North Point Street, San Francisco, Cal. Captain F. C. Boggs is general purchasing officer.

ALLENTOWN, PA.—Bids will be received by the Board of County Commissioners of Lehigh County, Court House, Allentown, Pa., until June 27 for furnishing material and installation of an electric light and power, sewerage and fire service at the Lehigh County Home, located near Wescoesville, South Whitehall Township as follows: Section 1. (a) the construction of a central power house, including foundation and stack; (b) furnishing and erection of power equipment, including boilers, flues, stack connections, feed pumps, feed water heaters, steam piping, valves, separators, fire service pump, generators, engines, switchboards; (c) complete installation of all inside and outside wiring, including all transmission lines, conduits, switches, poles, arc and incandescent lamps and fixtures; (d) construction of a fire service including reinforced concrete stand pipe, conduit and intake basins; (e) installation of a complete sewerage system. Plans and specifications may be seen at the office of the County Commissioners, copies of which may be secured from the Commissioners by depositing $100, which will be returned if a bid is submitted. J. S. Troxell is clerk of the board.

CARLISLE, PA.—It is reported that the Cumberland Railway Company will secure electricity for operating its electric railway between Carlisle and Newville from the power plant at Mount Holly Springs.

CHESTER, PA.—The Chester Traction Company is contemplating the construction of an electric railway from Chester to Boothwyn, a distance of five miles.

CLARION, PA.—The Clarion & East Brady Electric Railway Company is reported to be preparing plans for the construction of a power plant to be located at or near Rimersburg, Pa.

CLIFTON HEIGHTS, PA.—The Borough Council is reported to be considering the question of extending the lighting system, water works and making other public improvements, at a cost of $120,000.

NEW CASTLE, PA.—It is reported that the New Castle Electric Company is contemplating extensive improvements to its lighting system in New Castle, which will involve an expenditure of about $300,000. J. A. Toler is chief engineer.

PHILADELPHIA, PA.—The contract for the construction of a substation for the Philadelphia Transit Company, to be erected at Germantown Avenue and Erie Avenue, 50 x 32 ft., has been awarded to the Charles McCaul Company.

WARRIORS MARK, PA.—The Huntington & Center County Telephone Company has filed an amendment to its charter increasing its capital stock from $5,000 to $10,000. John T. Patton, of Huntington, Pa., is secretary.

WILKES-BARRE, PA.—The West Shore Railway Company, recently organized, it is said, will award contracts in the near future for the construction of an electric railway to connect Pittston, Forty Fort, Wyoming, Exeter, West Pittston and Wilkes-Barre, eight miles in length. The third-rail system will be used. J. L. Dunn, 54 Public Square, Wilkes-Barre, Pa., is secretary.

AIKEN, S. C.—The Carolina Manufacturing Company is contemplating the construction of a plant for manufacturing hosiery, boxes, etc., which will be equipped to be operated both by water and electrical power. W. H. Hite and others are interested in the project.

LEAD, S. D.—The Homestake Mining Company is contemplating making extensive additions to its reduction plant in the Black Hills District, which, it is said, will include a large hydroelectric power plant to furnish electricity for operating the machinery in the mills.

LIVINGSTON, TENN.—The Livingston Light & Power Company, recently incorporated to construct a hydroelectric power plant to generate electricity for lighting the town, is reported to have awarded contract for building the plant to the H. E. Speyer Company, of Algood, Tenn.

AUSTIN, TEX.—The City Council has authorized an election June 22 to vote on the proposition to grant a franchise to C. V. Bitkhead, of San Antonio, Tex., and associates for the construction of an electric railway in Austin. The franchise is to cover all the streets not occupied by the Austin Electric Company.

DALLAS, TEX.—Preparations are being made for the construction of an interurban electric railway between Dallas and Texas. J. Mercer Carter holds the franchise for the proposed railway.

FORT WORTH, TEX.—John B. Buchanan, of North Fort Worth, Tex., who is interested in the promotion of the proposed interurban electric railway between Fort Worth and Mineral Wells, states that he has $50,000 with which to begin construction work, and that he is guaranteed the right of way, depot grounds and $150,000 in stock of the proposed company by people along the line. The cost of the road is estimated at $1,500,000. Fort Worth, Chicago and New York capitalists are reported to be interested in the project.

GLEN ROSE, TEX.—It is reported that D. E. McDonald, of San Antonio, Tex., is contemplating the construction of a dam across the Paluxy River.

HOUSTON, TEX.—The Houston Electric Company is reported to be contemplating the erection of an extra overhead copper transmission line in the business section of the city, at a cost of $16,000.

HOUSTON, TEX.—The Houston Home Telephone Company is reported to have awarded a contract for the construction of a telephone system to Frank E. Ebersole, of Omaha, Neb. An automatic system will be installed, at a cost of $1,200,000.

PORT ARTHUR, TEX.—The Kansas City Southern Railroad Company is reported to be considering the installation of motor-driven centrifugal pumps on its docks at Port Arthur, Tex., for fire protection.

TERRELL, TEX.—The citizens are reported to have voted in favor of the proposition to issue $8,000 in bonds for improvements to the municipal electric light and water systems, including the construction of a new power house.

TEXAS CITY, TEX.—It is reported that the Texas City Transportation Company is planning to install an additional generating unit in its power house to supply the city with electricity for lamps and motors. The equipment will include an engine with a rating of about 150 hp, direct-connected to a 250-kw, alternating-current generator.

WACO, TEX.—C. Mailander & Son are building a plant in Waco, 100 x 165 ft., for the manufacture of bank and store fixtures. It is reported that the machinery will be equipped for electric motor drive. A large portion of the equipment has been provided for.

MANTI, UTAH.—The plant of the Manti Light & Power Company was destroyed by fire May 31, causing a loss of about $17,000. The Manti Light & Power Company was to have turned over its property to the city June 1, for which negotiations were nearly completed.

MURRAY, UTAH.—A report has been submitted to the Council by G. T. Ingersol, engineer, of Salt Lake City, Utah, for the construction of a water-power development, to cost $51,255. A turbine pump will be used.

SALT LAKE CITY, UTAH.—Plans are being considered by the

Utah Light & Railway Company for the construction of a substation, at a cost of $27,000.

SALT LAKE CITY, UTAH.—Contracts have been placed by the Utah Light & Railway Company for the construction of a large steam-generating plant to Westinghouse, Church, Kerr & Company, of New York, N. Y. The plant will be located on the Jordan River, near the present plant of the company. It will have an output of 11,000 hp and will involve an initial expendture of from $600,000 to $750,000. The plant will be built to provide space for an ultimate output of 75,000 hp.

BASIC CITY, VA.—Bids will be received by W. M. Page, treasurer, until June 20, for an electric motor and pump, having a rating of 800 gal. per minute, with total head of 225 ft.; 60-cycle, three-phase, 220-volt induction motor.

FRANKLIN, VA.—It is reported that the council has decided to make improvements to the municipal electric plant, to cost about $2,500.

FREDERICKSBURG, VA.—Arrangements are being made by the Electric Generating Company for the construction of its power house, to cost about $100,000, work on which will begin in the near future, William C. Whitner is chief engineer.

PALMYRA, VA.—The Palmyra Telephone Company has purchased the telephone system of the Fluvanna Telephone Company. It is reported that improvements will be made to the system, including the installation of an exchange in Palmyra; a metallic circuit will be installed and connections made with Richmond and Charlottesville. A. L. Cobb is general manager.

RICHMOND, VA.—The New River Power Company, recently incorporated, is planning to construct a hydroelectric power plant on New River. It is understood that four or more separate plants will be erected, with a combined output of 45,000 hp, with transmission lines and substations for transmission of electricity to cities, towns and mines in the southwestern part of Virginia, between Roanoke, Bristol, and to Bluefield, W. Va., and Mount Airy, N. C. The cost of the plant complete is estimated at $6,000,000. F. S. Viele, 49 Wall Street, New York, N. Y., is president.

COLFAX, WASH.—The local electric plant, owned by MacKenzie & Codd, of Colfax, is reported to have been purchased by the Washington Power Company, of Spokane, Wash., for a consideration of $100,000. F. R. Fantom, of Spokane, Wash., will be superintendent of the Colfax plant.

GREENACRES, WASH.—Application has been made to the County Commissioners by the Inland Empire Railroad Company for a franchise to erect and operate transmission lines on the streets in Greenacres.

LONGBRANCH, WASH.—The Pierce County Commissioners have granted the Sound Telephone Company a franchise to erect telephone lines through McNeill's Island, Meridian, Longbranch, Lake Bay, Glen Cove and Waughn. About 30 miles of line will be erected and four miles of submarine cable laid. B. B. Sampson, of Waughn, Wash., is president and S. S. Watkinson, of Longbranch, Wash., secretary.

MILES, WASH.—The Forestry Department of the Colville Indian Reservation has been authorized to erect 75 miles of telephone line and to build cabin stations on the reservation. Captain Webster, of Fort Spokane, is in charge.

SEATTLE, WASH.—The construction of an electric railway to extend from Seattle to North Seattle is under consideration. C. H. Shiels, of the Spokane Grain & Fuel Company, is interested in the project.

TACOMA, WASH.—Sealed proposals will be received at the office of Nicholas Lawson, commissioner of light and water, until July 5 for furnishing material and constructing a substation in Tacoma at South Twenty-fifth and C Streets. The work to include the construction of a concrete, stone and brick building, plans and specifications for which may be secured from the above office by depositing $50, which will be refunded when the plans and specifications are returned. The cost of the building is estimated at $95,200.

JANESVILLE, WIS.—The Wisconsin Telephone Company is contemplating the rebuilding of its entire system in Janesville, including the erection of a new exchange building. The cost of the work is estimated at about $60,000.

JANESVILLE, WIS.—The Janesville Electric Company has given notice of its intention of surrendering its franchise, which was purchased from the Thomson-Houston Company, of Boston, Mass., and granted to that company in 1885. The company will apply immediately to the Railroad Commission for an indeterminate franchise, under the law recently passed concerning public utilities.

LADYSMITH, WIS.—The Menasha Paper Company has recently placed an order with the Allis-Chalmers Company, of Milwaukee, Wis., for an 18 x 36, 100 r.p.m., "Reliance," heavy type, heavy duty Corliss engine.

LINDEN, WIS.—Plans are being considered by the Optimo Mining Company, of Linden, for enlarging its concentrating plant. If the project is carried out it is understood that the plant will be equipped for electrical operation.

NEILLSVILLE, WIS.—Preparations are being made by the Electric & Water Supply Company for the construction of a dam across Black River, two miles north of Neillsville, where it is estimated that between 800 hp and 1000 hp can be generated. It is understood that the power house will be within the dam. The capital stock of the company is reported to have been increased to $30,000.

SHELL LAKE, WIS.—The construction of an electric light plant at Pea Nut Ridge is reported to be under consideration.

SHERIDAN, WYO.—Preparations are being made by the Sheridan Railway & Light Company for the construction of an electric generating plant and machine shops, near Sheridan. It is understood that orders for equipment will be placed in the near future.

VANCOUVER, B. C., CAN.—The British Columbia Electric Railway Company is reported to have entered into a contract with the municipality of Point Grey to furnish electricity for lighting the town for a term of 10 years. About 500 electric lamps will be installed similar to those in use in Vancouver.

VICTORIA, B. C., CAN.—It is reported that bids will soon be called for 50 additional arc lamps, to cost about $3,500.

VICTORIA, B. C., CAN.—The contract for furnishing ornamental lamp posts and fittings for the street-lighting system on Douglass Street has been awarded to Hutchinson Brothers, at $54 each.

NEEPAWA, MAN., CAN.—The by-law authorizing the Town Council to sell the municipal telephone system to the Provincial Government has been endorsed by the ratepayers.

MONCTON, N. B., CAN.—It is reported that the ratepayers have endorsed the agreement prepared by the City Council with the Street Railway, Electric & Gas Company for leasing the municipal electric light plant for a term of 39 years.

BERLIN, ONT., CAN.—The transmission lines of the Hydro-Electric Commission from Niagara Falls to Toronto and from Niagara Falls to Berlin are nearly completed. It is expected that Berlin will be the first city to receive and utilize Niagara power.

INGERSOLL, ONT., CAN.—A committee, consisting of Mayor McKay and Reeve Fleet and Council Fleet, has been appointed to take over and operate the electric plant recently purchased from the Ingersoll Electric Power & Light Company. The plant will be equipped to receive and distribute electricity from Niagara Falls supplied by the Hydro-Electric Power Commission.

ST. CATHERINES, ONT., CAN.—The Ontario Power Company, of Niagara Falls, has applied to the City Council for a franchise to erect transmission lines in St. Catherines to sell and distribute electricity in opposition to the Cataract Company, which now has a monopoly of the city.

TORONTO, ONT., CAN.—The Toronto Electric Light Company is reported to have submitted a new offer to the City Council to obviate the prospective competition between the city and the company. The proposition submitted by the company provides: (1) That the city shall utilize the energy supplied by the Hydro-Electric Commission for the water-works pumping stations, street lighting and for lamps and motors required in the municipal buildings. (2) The company agrees to give the city the use of its pole lines for street lighting and power purposes, and to erect new pole lines as may be required by the city for the above purposes, said pole lines to be for the joint uses of the city and the company, and also offers to take off of the city's hands the poles already erected. (3) The company also offers the use of its conduits for the same purposes and will provide new conduits if required, the city to pay rental for the use of any of the conduits and over-head poles and lines, which rental shall be the interest, maintenance and depreciation only on such conduits and poles and lines. (4) The city to take over all the street and municipal property lighting as soon as it is ready for the same, irrespective of any contract existing for the supply of the same by the Toronto Electric Light Company. (6) The company will agree to remove all unnecessary overhead construction in the business portion of the city, and install underground conduits each year. (7) It also agrees to take and to pay for any quantity of power which the city is under contract to take from the Hydro-Electric Commission, which is not used for the purposes named in clause (1). The rates to be fixed and to be sufficient to provide for operating expenses and fixed charges, dividends at the rate of 10 per cent per annum on the capital stock, a reasonable allowance for depreciation and other necessary reserve funds, and the surplus over and above these requirements shall be applied to the reduction of rates to consumers. It is estimated that the above arrangement would save an expenditure of about $5,000,000. Henry M. Pellatt is president of the Toronto Electric Light Company.

WINDSOR, ONT., CAN.—The Electric & Distributing Company, recently organized with a capital stock of $2,500,000, has submitted a proposition to the municipality offering to guarantee the cost of the transmission line and other expenses in connection with the service of the Hydro-Electric Commission. The company agrees to enter into a contract with the city under the following conditions: It will endorse the contract of the city with the Hydro-Electric Commission for a minimum of 15,000 hp per annum, and agrees to take the surplus not required by the municipality and guarantee in a substantial manner satisfactory to the commission the obligations exacted covering the building of the transmission line, creating a maturity fund, fixed charges, interest, etc., as specified by the Hydro-Electric Commission. The company also offers to guarantee the bonds and assume the principal and interest upon them, paying yearly to the municipality the proportionate amount of the $100,000, together with the interest annually, the whole

amount to be paid within 30 years. The city will vote upon a by-law June 20 to issue $100,000 for the establishment of a plant in connection with the service of the Hydro-Electric Commission. The Electric & Distributing Company has secured a number of large contracts to furnish electricity through the equipping of the Michigan Central tunnel for electrical operation and in Detroit.

MOOSE JAW, SASK., CAN.—At an election to be held June 17 the by-law to appropriate $100,000, of which $35,000 will be used for extensions to the municipal electric light system, will be submitted to the ratepayers.

MONTREAL, QUE., CAN.—The stockholders of the Shawinigan Water & Power Company on July 8 will vote on the proposition to increase the capital stock of the company from $7,000,000 to $10,000,000 and also to issue debenture stock to an amount not exceeding $500,000.

MONTREAL, QUE., CAN.—The Montreal Light, Heat & Power Company has notified the city that it wishes to be relieved from the service of lighting the streets, and would terminate the present arrangement on Oct. 31, 1910. The company has offered to rent its pole lines to the city if a municipal service is decided upon. The Board of Control has decided to call for bids for street lighting.

GUADALAJARA, JALISCO, MEX.—The Chapala Hydro-Electric & Irrigation Company, of Guadalajara, which was formed by the consolidation of the Manuel Cuesta Gallardo and the Guadalajara Railway & Light Company, is constructing a 12,000-hp hydroelectric power plant at Puente Grande on the Santiago River, in the State of Jalisco. Siemens & Schuckertwerke, of Berlin, Germany, have the contract for construction of the plant. The equipment will include three turbo-generator units of 4000 hp each. Steel towers for carrying the transmission lines have already been erected to Hostotipaquillo and Etzatlan. The company has contracted with a number of large mining companies to furnish electrical service in those districts. It was expected to have the plant completed before this, but unavoidable delays have occured in construction work.

GUANAJUATO, MEX.—The Guanajuato Power & Electric Company, which is constructing a transmission line to San Luis Potosi, 87 miles in length, will erect a substation near the mining camp of San Felipe for the purpose of furnishing electricity to the Providencia Mining Company. The company is erecting double-circuit towers, six wires to the tower, for this line. It is expected to have the line completed by Sept. 1. Transmission lines will also be erected to the San Pedro mining district, State of San Luis Potosi, and to the Pinos district, State of Zacatecas. The company now has a total of 188 miles of transmission lines from its Zamora hydroelectric plant.

MADERA, CHIHUAHUA, MEX.—Dr. F. S. Pearson and associates, owners of the Mexico Northwestern Railroad, the Mexico Light & Power Company, who are establishing large industrial enterprises in this part of Northern Mexico, are reported to be contemplating the construction of a large hydroelectric power plant in this section to supply electricity for operating their lumber mills and other manufacturing plants. Concessions for the proposed plant have been acquired from Col. W. C. Greene.

MEXICO CITY, MEX.—The Mexican Tramways, Ltd., which has completed the extension of its system to Xochimilco, 15 miles in length, is now installing a transformer station at that place.

PACHUCA, MEX.—The property of the Compania Electrica & Irrigadora in the State of Hodalgo has been transferred to the Mexico Light & Power Company. The Mexico Company will connect the Pachuca plant with its transmission line now being erected from the Necaxa hydroelectric plant to the Pachuca mining district.

PACHUCA, MEX.—An official order has been issued suspending the construction work on the proposed electric railway of the Pachuca & Real Del Monte Mining Company, which is to connect the Rosario Mine with the Loreto hacienda. This action was taken on the complaint of the Pachuca Light & Power Company, which claimed that the construction of the road was an infringement of its rights.

KINGSTON, JAMAICA, WEST INDIES.—Plans are being made by the West India Electric Company to reconstruct and enlarge its hydroelectric power plant, located near Kingston, Jamaica. H. von Schon, of Detroit, Mich., has been engaged by the company to prepare plans for the proposed work.

New Industrial Companies.

THE AMERICAN ELECTRIC CHANGE MAKER COMPANY, of Seattle, Wash., has been incorporated with a capital stock of $100,000 by E. A. Wickline, Ernest Carstens and H. Rohwer, White Building, Seattle, Wash.

THE AMERICAN PNEUMATIC CONVEYING COMPANY, of New York, N. Y., has been chartered with a capital stock of $200,000 by W. M. Jacobus, W. W. Ackerman and J. A. Seely, of New York, N. Y. The company proposes to manufacture pneumatic conveyors and machinery.

THE ARMOUR CONCRETE CONSTRUCTION COMPANY, of Boston, Mass., has been chartered with a capital stock of $30,000 for the purpose of doing a general engineering and construction business. H. J. Osborne, of Dorchester, Mass., is president, and E. W. Osborne, of Somerville, Mass., is treasurer.

THE ATLANTA ELECTRIC MACHINE COMPANY, of Atlanta, Ga., has been incorporated with a capital stock of $9,000 by A. J. Bedwine, J. C. Oliver and W. H. Bangs. The company proposes to manufacture electrical machinery.

THE BURTON CONSTRUCTION COMPANY, of Chicago, Ill., has been chartered by B. E. Bondurant, J. C. Kistler and E. C. Chase. The company is capitalized at $10,000 and proposes to do a general construction and building business.

THE ELECTRICAL CONSTRUCTION COMPANY, of Holyoke, Mass., has been incorporated with a capital stock of $5,000 for the purpose of doing a general electrical business. Raymond P. Hill, of Holyoke, Mass., is president and treasurer; Harry A. Strong, of Northampton, Mass., Clerk.

THE ELECTRICAL UTILITIES COMPANY has filed articles of incorporation with a capital stock of $100,000. The incorporators are: G. W. Dorsey, Jr., George W. May and John Seller, all of Wilmington, Del.

THE ELECTROGRAPH COMPANY, of Montgomery, Ala., has been organized by Warren B. Buxton and others. The company is capitalized at $7,500 and proposes to manufacture and install electrical illuminating signs.

THE FEDERAL ENGINEERING & CONSTRUCTION COMPANY has filed articles of incorporation with the Secretary of State with a capital stock of $50,000. The incorporators are: H. T. Downing, W. N. Hase and H. T. Shelley, of Philadelphia, Pa.

THE FRED NASEN COMPANY, of New York, N. Y., has been chartered with a capital stock of $10,000 by Fred W. Nasen, 39 Cortlandt Street, New York, N. Y.; W. P. Waugh, Upper Montclair, N. J., and C. A. Nasen, of New York, N. Y. The company is capitalized at $10,000 and proposes to manufacture and construct electrical devices, motors, etc.

THE GEORGE T. LADD COMPANY, of Jersey City, N. J., has been incorporated with a capital stock of $100,000 by George T. Ladd, Robert H. Anderson, Harold W. Anderson, all of 63 Montgomery Street, Jersey City, N. J. The company proposes to do a general mechanical engineering business.

THE HASKELL-KITTEREDGE COMPANY, of Leominster, Mass., has been incorporated by Samuel J. Haskell and Arthur M. Kitteredge for the purpose of engaging in electrical and construction business.

THE INTERNATIONAL ELECTRIC PROTECTION COMPANY, of New York, N. Y., has been incorporated with a capital stock of $5,000,000 for the purpose of manufacturing electric signal systems. The directors are: Frank Rhodes, S. P. E. Friend, A. N. Trueb, of New York, N. Y.; Roberts Walker, of Scarsdale, N. Y.; S. M. Sloan, of Douglaston, N. Y.; F. A. Smith, of East Orange, N. J., and J. J. Quinlan, of Brooklyn, N. Y.

THE INTERNATIONAL SURFACE CONTACT COMPANY has filed articles of incorporation with a capital stock of $1,500,000. The incorporators are: S. M. Bowman, of New York, N. Y.; G. E. Somerville, Philadelphia, Pa., and G. W. Dorsey, Jr., of Wilmington, Del.

THE JACOBS ENGINEERING COMPANY, of Ottawa, Ill., has been charted with a capital stock of $30,000 by W. F. Jacobs, C. C. Jacobs and W. C. MacFarlane, of Ottawa, Ill. The company proposes to do an engineering and contracting business.

THE KEEP-STEP MOTOR COMPANY, of New York, N. Y., has filed articles of incorporation with a capital stock of $10,000 for the purpose of manufacturing and dealing in electric motors, generators, rectifiers, etc. The incorporators are: Ernest Wheeler, of Yonkers, N. Y.; Tristan B. Johnson, New York, N. Y., and Walter Wheeler, New York, N. Y.

THE NATIONAL ELECTRIC STEEL COMPANY, of Camden, N. J., has been chartered with a capital stock of $2,500,000 to deal in iron and iron ore, etc., by F. R. Hansall, George H. B. Martin and S. C. Seymour, all of Camden, N. J.

THE NEW YORK SMOKE SEPARATING COMPANY has been chartered with a capital stock of $500,000 by G. G. Steigler, R. C. Lupton and H. W. Nock, of Wilmington, Del.

THE NORTH EASTERN PENNSYLVANIA MOTOR COMPANY has been chartered with a capital stock of $100,000 by W. A. McCowell, W. L. Perry, W. S. McMillan and I. Mitchell, of Scranton, Pa.

THE PEERLESS LIGHTING COMPANY, of St. Louis, Mo., has been chartered with a capital stock of $13,000 for the purpose of dealing in electric fixtures, etc. The incorporators are: Charles E. Gossman and Richard Hennes.

THE PROGRESSIVE INVENTIONS COMPANY, of New York, N. Y., has been incorporated by R. Messlin, P. Leuter, of Bronx, and I. Frey, of New York, N. Y. The company is capitalized at $50,000 and proposes to perfect various inventions and manufacture and deal in vibrators, vacuum cleaners and novelties, etc.

THE SAFETY TRAIN CONTROL COMPANY, of New York, N. Y., has been incorporated with a capital stock of $800,000 to manufacture and deal in appliances for railroads, etc. The incorporators are: H. D. Patterson, of Mount Vernon, N. Y.; M. U. Ely, of Brooklyn, N. Y., and D. E. Pack, of New York, N. Y.

THE SMITH MOTOR CAR COMPANY, of Terre Haute, Ind., has been incorporated with a capital stock of $25,000 by W. B. Smith, M. B.

Sheldon and E. B. Smith. The company proposes to manufacture automobiles, automobile parts, making a specialty of the electric automobiles.

THE TRIGGS SMOKE PREVENTION & FUEL SAVING COMPANY has filed articles of incorporation with the Secretary of State with a capital stock of $100,000. The incorporators are: Charles H. Triggs, Walter P. Lewis and Andrew H. Sanborn, all of Wilmington, Del.

THE TROLLEY AUTOMATIC LOCK COMPANY, of New York, N. Y., has been incorporated with a capital stock of $200,000 by J. H. Taylor, A. B. Warwick and A. A. Meeker, of New York, N. Y. The company proposes to manufacture automatic locking devices for trolley poles and other patented articles.

THE WAUD MANUFACTURING COMPANY, of New York, N. Y., has been chartered with a capital stock of $10,000 by E. L. Dolder, 310 East Seventeenth, New York, N. Y.; V. Cheesman and W. A. Walling, of New York. The company proposes to manufacture lamps, mirrors, etc., electrical supplies and articles for heating and lighting, etc.

THE WEST HUDSON CONSTRUCTION COMPANY, of New York, N. Y., has been incorporated as general contractors and to do construction work in all branches, railroads, bridges, reservoirs, etc. The company is capitalized at $500,000, and the incorporators are: Noah A. Stancliffe, 219 West 104th Street, New York, N. Y.; Frederick P. Whitaker, Cliffside, N. J., and John J. Donovan, of New York, N. Y.

THE WILLIAM MURDOCK COMPANY, of Chelsea, Mass., has been incorporated with a capital stock of $10,000 to manufacture telephone and electrical machines. The directors are: W. J. Murdock, president, and Daniel R. W. Murdock, treasurer, both of Everett, Mass.

New Incorporations.

DECATUR, ALA.—The Decatur & Falls City Development Company has been organized by E. H. Allison, of Decatur, Ala., for the purpose of building railways, etc.

LITTLE ROCK, ARK.—The Camden Power Company has been chartered with a capital stock of $100,000 for the purpose of establishing power plants to generate electricity; also for distributing electricity for lamps and motors.

COLUSA, CAL.—Articles of iincorporation have been filed for the Marysville & Colusa Railway Company with a capital stock of $1,500,000 for the purpose of constructing an electric railway from Marysville through Yuba City to Colusa.

SAN FRANCISCO, CAL.—The Central Power Company has been incorporated by J. J. Lerman, S. D. Woods and R. W. Dennis. The company is capitalized at $50,000.

SAN FRANCISCO, CAL.—Articles of incorporation have been filed for the Hydro-Electric Company with a capital stock of $1,000,000 by F. J. and J. A. Coster and J. H. Day.

CENTER, COL.—Articles of incorporation have been filed for the Interurban Telephone Company with a capital stock of $20,000 by E. J. Culp, John Welty and W. A. Moffinger.

LAMAR, COL.—The Clay Creek Rural Telephone has been incorporated with a capital stock of $10,000 by R. T. Carnahan, Isaac Grimsley and J. M. Wright.

TELLURIDE, COL.—The Sylvan Lake Power Company has been incorporated with a capital of $500,000 by E. A. Woods, A. T. Woods and H. M. Hogg.

WILMINGTON, DEL.—Articles of incorporation have been filed for the International Cable Railway Company by William J. Maloney, Millard C. Taylor and E. Butterworth Davis, all of Wilmington, Del.

WILMINGTON, DEL.—The New York State Wireless Telephone & Telegraph Company has been incorporated with a capital stock of $2,500,000 by Harry Darlington, E. R. Devine, E. R. Cochra, Jr., all of Wilmington, Del.

LEWISTON, IDAHO.—Articles of incorporation have been filed for the Grande Ronde Power Company with a capital stock of $1,000,000. The company has also filed deeds to the power sites and holdings of the Lewiston-Clarkston Company on the Grande Ronde River. It will be the operating company of the new interests. Extensive surveys of the holdings and the development of 10,000 hp will commence in the near future. The proposed plant will replace the hydroelectric power plant now located at Asotin Creek. Bonds to the amount of $2,000,000 have been authorized by the company.

KANKAKEE, ILL.—The Kankakee Power Company, a Delaware corporation, has filed articles of incorporation with the Secretary of State with a capital stock of $600,000 to operate a light, heat and power plant.

EVANSVILLE, IND.—Articles of incorporation have been filed for the Evansville, Mount Carmel & Olney Electric Railway Company by E. Q. Lackrie, C. J. Seibert and S. J. Laubscher, of Evansville; Thomas Marvel, E. B. Rider, of Cynthiana, Ind.; Aden Knoph and J. F. Hyatt, of Olney, Ill.; Lewis Seitz and Robert Parkinson, of Mount Carmel, Ill.

SEYMOUR, IND.—Articles of incorporation have been filed for the Seymour Public Service Company by T. C. McReynolds, W. W. Layton, C. E. Layton and C. W. McReynolds. The company is capitalized at $100,000 and proposes to construct and operate a plant to supply electricity for lamps, heat and motors, also steam heat in Seymour and vicinity.

DES MOINES, IA.—The Mutual Telephone Company of Fayette County has been organized with a capital stock of $10,000 by L. M. Grimes and others.

ABBYVILLE, KAN.—The P. A. & P. Telephone Company has been incorporated with a capital stock of $10,000 by L. C. Brown, of Nickerson, Kan.; H. G. Curnutt, C. S. Gibbens and W. C. Detter, all of Nickerson, Kan.; J. M. Hinshaw, of Plevina and F. G. Ray, of Abbyville, Kan.

FULTON, KAN.—The Mutual Telephone Company, of Fulton, has been incorporated with a capital stock of $25,000 by F. S. Hall, E. T. Shaffer, F. H. Niles, Alexander Mason and D. C. Jenkins.

YORK HARBOR, MAINE.—The Agamenticus Electric Light Company has filed articles of incorporation with a capital stock of $100,000. The incorporators are: J. G. Shaw, of Biiddeford, Maine; George F. West, Frank D. Marshall, Edward C. Hersey and George Wescott Beyer, of Portland, Maine. The object of the company is to take over the property of the Agamenticus Light & Power Company, which was recently purchased by the York Light & Heat Company. It is proposed to increase the service of the old company, electricity for which will be supplied from the plant of the York Light & Heat Company at Biddeford, Maine.

CHELSEA, MASS.—The William A. Murdock Company has been chartered with a capital stock to construct and operate a telephone and telegraph system. The officers of the company are: William J. Murdock, of Everett, Mass., president; James M. Murdock, of Boston, Mass., vice-president; Samuel R. Murdock, of Everett, Mass., treasurer.

MANSTON, MINN.—The Manston Telephone Company has been incorporated with a capital stock of $5,000 by P. E. Stonehart, R. Henderson and L. P. Lomsdale.

OLIVIA, MINN.—The Renville County Telephone Company has been incorporated with a capital stock of $100,000. The incorporators are, A. C. Bowe, president and treasurer; W. J. Huff, vice-president and secretary, and M. F. Bowe, all of St. Paul, Minn.

PINE CITY, MINN.—The Co-operative Telephone Company has been incorporated with a capital stock of $10,000 by F. H. Walters, I. D. Curryer and Benjamin Schlafile, all of Hinckley, Minn.

CUBA, MO.—The Cuba Telephone Company has been incorporated by A. M. Benton, C. E. Dunkelburg and C. R. Fitch. The company is capitalized at $8,000.

GREENFIELD, MO.—The Mutual Telephone Company has been chartered with a capital stock of $20,000 by J. C. Schrouse, J. F. Wetzell, R. S. Long and others.

KANSAS CITY, MO.—The Electric Power Company has been chartered with a capital stock of $250,000 by W. D. Wood, Estel Scott and J. E. E. Trogodon.

GREAT FALLS, MONT.—The Great Falls Power Company has filed articles of incorporation with a capital stock of $15,000,000. The incorporators are: P. E. Bisland, G. F. Canfield and Marcus Daly, all of New York, N. Y.; C. F. Kelly and J. G. Morony, of Butte, Mont.

NEWARK, N. J.—The Public Service Electric Company has been incorporated with a capital stock of $15,000,000. The company is a subsidiary of the Public Service Corporation of New Jersey, which proposes to divide its system into three large departments, traction, gas and electricity. It is said that no stock of the company would be offered for sale. The incorporators are: Thomas N. McCarter, president; Edwin W. Hine, secretary, and Dudley Farrand, general manager of the Public Sevice Corporation. James P. Dusenberry, treasurer of the Public Sevice Corporation is named as registered agent.

ANDOVER, N. Y.—The Andover Telephone Company has filed articles of incorporation with the Secretary of State. The company is capitalized at $5,000 and proposes to construct and operate telephone lines in Steuben and Allegheny Counties. The directors are: Jesse S. Phillips, Grayton L. Eafly, Earl A. Richardson, Frank S. Clark, B. S. Brundage, F. W. Burrows, Erwin D. Baker, John E. Cannon and Henry Stephens.

BOLTON LANDING, N. Y.—The Bolton Light & Power Company has filed articles of incorporation with the Secretary of State. The company is capitalized at $25,000 and proposes to generate electricity for lamps and motors. The incorporators are: F. R. Smith, D. L. Rogers and S. G. Finkle, all of Bolton Landing, N. Y.

BROOKLYN, N. Y.—Articles of incorporation have been filed for the Brooklyn & Jamaica Bay Railway Company for the purpose of building an electric railway from Brooklyn to Jamaica Bay, a distance of three miles. The company is capitalized at $100,000 and the incorporators are: H. J. Subers, of Ashboarne, Pa.; N. S. Easton, Daniel Von Wein and E. S. Churchill, of New York, N. Y., and F. B. Lupten, of Brooklyn, N. Y.

ESSEX, N. Y.—The Essex Mutual Telephone Company has been incorporated with a capital stock of $1,500 by Charles W. Tucker, P. H. Boyle and Nelson A. La Roe, all of Essex, N. Y.

KEESEVILLE, N. Y.—The Ausable Telephone Company has been incorporated with a capital stock of $50,000. The directors are: J. M. Weaver, B. M. Ramsay, of Plattsburgh, N. Y.; C. H. Prescott and others, of Keeseville, N. Y.

NEW YORK, N. Y.—The Federal Light & Traction Company has been

incorporated under the laws of New York State with a capital stock of $11,000,000 for the purpose of taking over various utilities companies in Colorado, New Mexico and Wyoming. The companies that will be included in the merger when completed include the following: Grays Harbor Railway & Light Company, of Aberdeen, Wash.; Sheridan Electric Light & Power Company, of Sheridan, Wyo.; the Rawlins Electric Light & Fuel Company, of Rawlins, Wyo.; the Montrose Electric Light & Power Company, of Montrose, Col.; the Hobart Light & Power Company, of Montrose, Col.; the Albuquerque Electric Power Company, the Albuquerque Gas, Electric Light & Power Company, both of Albuquerque, N. M.; the Las Vegas Light & Power Company and the Las Vegas Transit Company, both of Las Vegas, N. M.; the Tucson Gas, Electric Light & Power Company and the Tucson Rapid Transit Company, of Tucson, Ariz.

ROCHESTER, N. Y.—The Rochester Belt Line Railroad Company has filed articles of incorporation with a capital stock of $2,500,000. The incorporators are: Frank A. Dudley, of Niagara Falls, N. Y.; Henry C. Brewster, John F. Alden, of Rochester, N. Y., and others.

WALDEN, N. Y.—The Walden Telephone Company has been incorporated with a capital stock of $30,000 by C. Fred Fowler, Anson B. Fowler, Joseph Oliver, of Walden, N. Y., and others.

COLUMBUS, OHIO.—The Fifth Avenue Railway & Light Company has been chartered with a capital stock of $10,000 by A. C. Wolfe, E. W. Yantes, J. E. Fippin and J. W. Jennings. The company proposes to build a crosstown railway on Fifth Avenue in Columbus, Ohio.

COLUMBUS, OHIO.—The Columbus Interurban Terminal Company has been chartered by J. B. Foraker, Jr., F. A. Healy, Dana Stevens, W. H. McAllister and W. Kesley Schoepf, all of Cincinnati, Ohio. The company is capitalized at $10,000 for the purpose of constructing an interurban terminal station in South Third Street, plans for which have been prepared. Bonds to the amount of $200,000 have already been provided for the construction of the building.

LIMA, OHIO.—Articles of incorporaton have been filed for the Western Ohio Railroad Company with a capital stock of $10,000 by Frank H. Ginn, Albert E. Green, G. M. Cummings, Grover Higgins, and John M. Garfield. The company proposes to construct and operate an electric railway between Dayton and Toledo, with branches from Wapakoneta to Celina and from St. Marys to Lorain.

BURNS, ORE.—The Burns Independent Telephone Company has been chartered with a capital stock of $5,000 by J. W. Geary, V. D. Baker and Charles W. Ellis.

CHESTER, PA.—The Southern Pennsylvania Traction Company has been incorporated with a capital stock of $10,000 to operate electric railways or cable lines and to furnish power in Delaware County. The incorporators are: G. R. Webb, of Baltimore, Md.; O. T. Crosby, of Warrenton, Md.; D. L. Evans, of Pottstown, Pa.; Jacob H. Rhoades and William H. Snyder, of Philadelphia, Pa.

FREDERICKSBURG, PA.—Articles of incorporation have been filed for the Mt. Zion & Fredericksburg Rural Telephone Company with a capital stock of $5,000 by H. Gingrich and others.

JOHNSTOWN, PA.—The Tower City, Reiner City & Johnstown Street Railway Company has been chartered by Joseph W. Moyer, of Pottsville, Pa., president; W. E. Harrington, John H. Williams, of Pottsville, Pa.; A. B. Greemshield, of Philadelphia, Pa.; Edgar D. Rank, of Williamstown, Pa.; N. D. Yoder, of Hegins, Pa., and J. F. Romberger, Berrysberg, Pa. The company is capitalized at $100,000 and proposes to construct an electric railway from the terminus of the Lyknes & Williams Valley Street Railway at the eastern end of Dauphin County to Johnstown, a distance of three miles.

WILLIAMSPORT, PA.—The West Branch Bell Telephone Company has been incorporated with a capital stock of $10,000.

WILLIAMSPORT, PA.—The Sylvan Dell Park Company has been chartered with a capital stock of $24,000 to construct a street railway from South Williamsport to Sylvan Dell Park, a distance of 3½ miles. H. W. Whitehead is president.

YORK, PA.—The Pleasant Hill Telephone Company has been granted a charter with a capital stock of $10,000. The incorporators are; John F. Waltersdorff; Willis H. Houck, John F. Norris, Henry E. Nail, John H. Markle and Milton S. Sterner.

GREER, S. C.—The Greer Light & Power Company has been incorporated with a capital stock of $25,000 for the purpose of doing a general lighting and power business. The incorporators are: Z. V. Taylor, of Greensboro, N. C., and N. A. Coke, of Charlotte, N. C.

YALE, S. D.—Articles of incorporation have been filed for the Lakeside Telephone Company with a capital stock of $15,000 by J. M. Pullman, Jacob T. Hofer and Ludwig Hobe.

LIVINGSTON, TENN.—Articles of incorporation have been filed for the Livingston Light & Power Company by H. E. Speyer, F. E. Bracey, D. W. Harmon, W. H. Estes and M. H. Hankins. The company proposes to develop water power to generate electricity.

NASHVILLE, TENN.—The Wautauga Power Company has been granted a charter by the Secretary of State. The company is capitalized at $150,000 and proposes to develop water power from the Wautauga River. The incorporators are: H. H. Shelton, E. C. Alexander, M. A. Wells, J. C. Price and James D. Jenkins.

BELLINGHAM, WASH.—The Bellingham-Skagitt Railway Company has been incorporated by the Stone & Webster Corporation, of Boston, Mass., under the laws of Maine, for the purpose of constructing an interurban railway between Bellingham and Skagitt, a distance of 33 miles. C. W. Howard is local counsel for the Stone & Webster Corporation.

CLE ELUM, WASH.—Articles of incorporation have been filed for the Cle Elum Falls Power Company, with a capital stock of $1,000,000, by H. J. Manning and others.

VANCOUVER, WASH.—Articles of incorporation have been filed for the Vancouver, Camas & Washougal Traction Company by H. C. Phillips, W. D. Smith and E. M. Rands. The company is capitalized at $100,000 and proposes to build a traction line from Vancouver to Washougal.

PARKERSBURG, W. VA.—The Burns, Glenville & Parkersburg Company has been incorporated with a capital stock of $10,000 by N. J. Barlett, J. B. Supler, of Clarksburg, W. Va.; L. W. Bartlett, C. E. Hines and Henry Spies, of Buckhannon, W. Va. The company proposes to construct an electric railway from Burnsville to Parkersburg, via Glenville.

PULASKI, WIS.—The Pulaski Merchants & Farmers Telephone Company has been chartered with a capital stock of $5,000. The officers of the company are: J. Peplinski, president; Louis Prokopobitz, vice-president, and F. K. Ranisjewski, secretary and treasurer.

PACHUCA, MEX.—The Campania de Luz, Fuerza y Ferrocarriles de Pachuca has been organized with a capital stock of $1,500,000 for the purpose of establishing electric plants and street railway systems in Pachuca and vicinity. The company proposes to construct a hydroelectric plant and acquire water rights, construct and operate electric street railway systems and furnish electricity for operating mines and other industries. The directors are: Joaquin D. Cassasus, president; Jacinto Pimental, Jose Luis Requena, all of Mexico City; Leandro F. Payro and Rafael M. Arozarena, of Pachuca. Theodore Brandenburg is general manager.

Personal.

MR. B. A. BEHREND is in Europe for a visit of several months.

MR. W. L. R. EMMET has received the degree of Doctor of Science from Union University.

MR. F. V. HENSHAW has returned to New York after a two months' trip to the Pacific Coast.

MR. F. N. KOZIELL has been appointed general manager of the Consolidated Lighting Company, Montpelier, Vt.

PROF. J. W. ESTERLINE has resigned from the faculty of Purdue University in order to devote all of his time to engineering work.

MR. S. MORGAN BUSHNELL, engineer of the contract department of the Commonwealth Edison Company, left Chicago on June 9 for a trip to Europe of two months' duration.

MR. JAMES C. DOW has resigned from the United Missouri Power Company after eight years' service to go with the Great Falls Waterpower and Town-site Company, Butte, Montana.

DR. C. F. LORENZ, formerly of the Queen's University, Kingston, Canada, has become associate physicist in the physical laboratory of the National Electric Lamp Association at Cleveland, Ohio.

MR. JAMES G. WRAY, chief engineer of the Chicago Telephone Company, has been elected an honorary member of the Wisconsin University Chapter of the engineering fraternity Tau-Beta-Pi.

PROF. F. M. DENTON, of Carnegie Schools, Pittsburgh, will sail shortly to take up his new work as associate head of the department of electrical engineering, Northampton Institute, London, England.

MR. J. H. PERKINS has resigned as secretary and general manager of the Wilkes-Barre Gas & Electric Company to become consulting electrical engineer for the Susquehanna Railway & Light Company.

MR. LOUIS J. COSTA, formerly District Manager of the Jandus Electric Company, with office in Philadelphia, has resigned to accept a position with the Allis-Chalmers Company, his resignation having taken effect June 1. Mr. Costa will be connected with the Philadelphia office of the latter company.

MR. H. VON SCHON, consulting engineer, of Detroit, Mich., has been engaged by the West India Electric Company, Ltd., to prepare plans for a hydroelectric plant near Kingston, Jamaica Island. Mr. von Schon sailed on Saturday, June 11, and expects to be in the West Indies for about a month.

PROF. F. W. SPRINGER, of the department of electrical engineering of the University of Minnesota, left New York, June 11, on the Red Star liner *"Vaderland"* for Antwerp, en route to Berlin, Germany, where he will spend his sabbatical year in investigating German teaching methods and shop testing practices.

DR. MAX VON RECKLINGHAUSEN is the co-author of a paper presented before the French Académie des Sciences on the subject of the sterilization of water in large quantities by means of ultra-violet rays from Cooper Hewitt lamps. It is stated that a cubic meter of water can be sterilized at a maximum expenditure of 36 watt-hours, which corresponds to about 140 watt-hours per 1000 gal.

MR. C. G. YOUNG, who makes a specialty of compiling reports for financing and devising methods for the operating of public utilities and industrial companies, has taken additional office space at No. 60 Wall Street to meet the increasing demands of his business. Mr. Young, who was formerly identified with J. G. White & Company, sailed for Europe on Wednesday on the Cunard Line steamer *Lusitania* for a business trip.

PROF. ERNEST RUTHERFORD, director of the physical laboratories at the University of Manchester, well known for his work with radium, has been awarded the Barnard medal, which was established by former-president Barnard of Columbia University to encourage research in physical and astronomical sciences. The former recipients have been Prof. William Ramsam, Lord Rayleigh, Prof. Wilhelm Conrad von Roentgen and Prof. Henri Becquerel.

MR. LEONARD ANDREWS, managing director of the Key Engineering Company, Ltd., London and Manchester, England, will arrive in New York on June 28 on another flying visit, and will be at the Manhattan Hotel for several weeks. After leaving New York Mr. Andrews will visit Canada, New Zealand and Australia, returning to England via India and Egypt. While here he will look into new electrical specialties, etc., with a view to their exploitation by his firm in Great Britain and the British Colonies.

MR. LUCIUS I. WIGHTMAN, for the past six years advertising manager for the Ingersoll-Rand Company, New York, has resigned his position, and will open an office in New York City as an independent specialist in machinery advertising, handling the accounts of manufacturers of machinery and engineering products. Mr. Wightman, who is a graduate engineer and the author of a text-book on compressed air, joins with his special knowledge in the above line a prior experience of years in practical mechanical and electrical engineering, construction work, machine design and manufacture and machinery selling.

MR. OREN A. FARRAR, who has been general manager of the Northern Idaho & Montana Power Company for the past three years at Kalispell, Mont., which company operates telephone, light and water systems in Flathead County, has been transferred to the Portland, Ore., office of the H. M. Byllesby Company as assistant to the vice-president in this district. While Mr. Farrar was in charge of the Kalispell system he made improvements to the water-turbine plant at Big Fork to the extent of $700,000; constructed new dams, flumes, power house and transmission lines; installed a new steam-turbine plant at Polson, Mont., took over the Whitefish plant of the Big Bend Light & Power Company and started the erection of a substation and transmission line to Columbia Falls, a distance of 15 miles. As a token of appreciation, the employees presented Mr. Farrar, upon his departure, a handsome, solid gold watch fob and emblem of the Elks' Order. Mr. Farrar began his career with the Allis-Chalmers Company, working up into a salesman for the Detroit office. He left there to take up duties as manager of the Mobile Gas & Electric Company, Mobile, Ala., and was transferred from that office to the Big Fork Electric Power Company, Big Fork, Mont. After the consolidation of this company with the Kalispell Water & Electric Company he was made general manager. Later those companies were taken over by the Northern Idaho & Montana Power Company.

MR. OREN A. FARRAR.

Obituary.

MR. CLINTON CHARLES BURR, chief engineer of the Northern Electrical Manufacturing Company, Madison, Wis., died at Lincoln, Neb., May 28. Mr. Burr had been in failing health for some months past, and in March last went to Lincoln for treatment, where his health improved for a time, but finally failed gradually until the end came. He was born at Albion, Mich., Dec. 30, 1870, prepared for college at the Albion High School and later entered the University of Michigan at Ann Arbor, where he took the course in electrical engineering. He then entered the employ of the General Electric Company at Schenectady, and one of his assignments was to Quito, Equador, where he superintended the installation and starting of a large hydroelectric plant, which he operated through the years 1899, 1900 and 1901. Returning to this country, he was identified for a period of one year with the Lincoln Traction Company, Lincoln, Neb., leaving there to enter the engineering department of the Ft. Wayne Electric Works, at Ft. Wayne, where he remained until the year 1905. He then became chief engineer of the Phœnix Electric Company, Mansfield, Ohio, and later of the Mechanical Appliance Company, at Milwaukee, entering the employ of the Northern Electrical Manufacturing Company, at Madison, in Oct., 1908. Very shortly thereafter he was appointed chief engineer of that company, which position he occupied at the time of his death. Mr. Burr was a man of wide experience and acquaintance in the electrical field, and because of the high order of his technical ability, his unfailing courtesy and his cheerful disposition was held in the highest esteem by all those with whom he came in contact. He is survived by a widow who will, for the present, retain her residence in Madison.

Trade Publications.

WATT-HOUR METERS, of the mercury-floating type, are described in detail in the Convention Bulletin issued by the Sangamo Electric Company, Springfield, Ill.

CURTIS TURBINE INSTALLATIONS.—An attractive publication No. 4732 recently issued by the General Electric Company contains upward of 50 illustrations of installations of Curtis steam turbo-generators of various ratings.

ELECTRIC HEATING DEVICES.—The Diamond Electric Company, of Binghamton, N. Y., has issued a four-page folder describing its "Delco" electric range, an illustrated account of which was published in the May 19 number.

ELECTRIC FANS.—The Pettingell-Andrews Company, Boston, Mass., has issued a catalog entitled "Electric Fans," in which are described and illustrated two lines of motor fans: The Tindell and the alternating current General Electric types. The catalog contains 35 pages, 8 in. x 10½ in., and is a very tasteful book.

LUMINOUS ARC LAMPS.—In Bulletin No. 4741, issued by the General Electric Company, are illustrated and described luminous arc lamps for multiple circuits that are especially adapted for lighting machine shops, foundries, factory yards and places where the slight fumes given off by the lamps are not objectionable.

ENAMELED WIRE.—The Belden Manufacturing Company, Chicago, has issued a circular giving data relating to enameled wire and specifications setting forth the requirements which its wire fulfills. Three types of wire are listed, namely, enamel, cotenamel (one enamel and one cotton) and silkenamel (one enamel and one silk).

PORTABLE ELECTRIC LAMP.—L. A. Williamson Company, Boston, Mass., has brought out an electric "Flexilyte" comprising a case with about 15 ft. of lamp cord, an attaching plug and a crank for winding the cord on the center portion which is the lamp socket. Its uses and advantages are illustrated and described in a booklet just issued.

EXHAUST FANS.—Bulletin No. 5351 of the Western Electric Company describes in considerable detail different types of motor-driven exhaust fans. A complete description of the design and construction of the several types of the fans is included in the bulletin with appropriate illustrations. These fans are especially adapted for use in the ventilating of school houses, public buildings, mines, etc.

HOUSE LIGHTING.—A booklet entitled "How to Light Your Home by Electricity" has been issued by the Electric Storage Battery Company, Philadelphia. The booklet gives much information concerning the small isolated lighting plant consisting of a gas engine, generator and battery, which makes a very attractive equipment for suburbanites or farmers who do not live within the radius of the service offered from a central station.

SWITCHBOARD WATT-HOUR METER.—Advance information on an astatic direct-current, watt-hour meter is given in a folder issued by the Duncan Electric Manufacturing Company, Lafayette, Ind. The instrument's new features: The glass case can be removed from the front of the board; the recording mechanism is easily removed and the armature can be lifted out without dismantling the meter; coils are provided which enable the calibration of the meter without the use of external instruments. This last feature is patented.

ELECTRIC LAUNDRY MACHINE.—The "Thor" electric laundry machine comprises a self-reversing wooden cylinder turning in a galvanized iron body and a reversible three-roll wringer, both driven by an electric motor. The cylinder is perforated, and each time its movement is reversed the clothes are spread out in a new position and subjected to the action of soapy water. In this way they are cleaned without damaging the fabric. The machine is built by the Hurley Machine Company, of Chicago, Ill., and its various advantages are pointed out in a 20-page booklet issued by the company.

FOUNDRY HEATING SYSTEMS.—A pamphlet with this title has been issued by the Green Fuel Economizer Company, of Matteawan, N. Y. Included are detailed descriptions of two novel installations recently put in by this company. In one of these a foundry of 515,000 cu. ft. capacity and having walls made up entirely of glass was successfully heated by a small four-section "Positivflo" heater. The pamphlet also describes a novel arrangement of ducts whereby the heat is supplied just where needed by the workmen, at the same time furnishing them with fresh air, and forcing the smoke and gases out of the building through the skylight. By using the right number of heater sections, and regulating the volume of air delivered, it was found possible to maintain the foundry at such a temperature that cores and molds are prevented from freezing, no matter how severe the weather conditions.

BUSINESS NOTES.

WISCONSIN ENGINE COMPANY CHICAGO OFFICE.—Mr. George B. Foster has been appointed Chicago sales manager of the Wisconsin Engine Company, with offices in the Fisher Building.

NORTHERN CRANES.—The Detroit United Railways have installed in two of their substations 10-ton, hand-power Northern Cranes, 30-ft. to 34-ft. span. These cranes were furnished and installed by the Northern Engineering Works, Detroit.

TRUMP TURBINES.—During the present month the Trump Manufacturing Company, Springfield, Ohio, has received orders for 17 turbines for delivery in Ohio, Pennsylvania, Iowa, Washington, Montana, Alabama, Massachusetts, Michigan and Canada.

ANGLE COMPOUND ENGINES.—Of 18 Angle compound engines recently sold by the American Engine Company, Bound Brook, N. J., two are for the Weston Electric Light Company, Weston, Mass.; one for the Amityville Electric Light Company, Amityville, N. Y, and two for the Fulton County Gas & Electric Company, Gloversville, N. Y.

THE RAPP-ZALLINGER ELECTRIC COMPANY, Indianapolis, has put on a night shift. Additional buildings will be erected and other arrangements made to increase the capacity of the plant. This company was formed a short time ago in South Bend and then moved to Indianapolis. Mr. Rapp and Mr. Zallinger, who head the company, were formerly connected with the Ft. Wayne Electric Works.

LORD MANUFACTURING COMPANY NEW ENGLAND AGENCY.—The Mathias-Hart Company, 514 Atlantic Avenue, Boston, has been appointed as New England agent for the Lord Manufacturing Company. The Lord Manufacturing Company's products have been adopted as standard by many New England properties and through this connection they are better able to serve New England patrons.

MR. LEONARD ANDREWS, managing director of the Key Engineering Company, Ltd., London and Manchester, will be at the Hotel Manhattan, New York, for several weeks after June 28, and will be glad to hear of new engineering specialties, processes, etc., for which there is likely to be a demand in Great Britain or the British colonies. The Key Engineering Company has been instrumental in placing on the British market various electrical appliances originating in other companies, including fibre conduit, large gas engines of outputs from 500 to 5000 hp. of German origin, etc.

THE HOLOPHANE COMPANY announces that it has developed a new "Standard Line" of reflectors for tungsten lamps which will supersede the present high-efficiency types. The new reflectors, besides being more efficient than the present types, are considerably more decorative. The company will put in effect on July 1 several changes in prices and discounts on Holophane material, after which date packing charges will be entirely eliminated. The new list prices will mean practically no changes in the net prices to the various classes of trade, the change leaving the net prices practically the same as they are now.

BOGUS IGNITION PARTS.—The Connecticut Telephone & Electric Company, of Meriden, Conn., states that it is experiencing a great deal of trouble due to irresponsible manufacturers placing on the market imitation parts for Connecticut coils. In all cases brought to its attention these spurious parts are poor imitations of the original. The vibrator blades are much thinner and smaller in diameter than the genuine, with the result that the coil will fail to act properly, missing and not giving the engine its proper power. Some of the spurious parts have been fitted with inferior grade of platinum, and in some cases German silver and other alloys have been used in place of platinum points with the result that they quickly ruin their coil by breaking down or cause skipping of the engine, the car thus not running with its full power. In order to protect the users of the Connecticut coils against the use of these bogus parts, in the future all these parts will bear the company's full name.

THE AMERICAN ELECTRIC FUSE COMPANY, Muskegon, Mich., has nearing completion a new brick factory building which will take care of its rapidly expanding business in enameled magnet wire and coil windings. The American Electric Fuse Company was the pioneer in the manufacture of enameled magnet wire, being the first to foresee the possibilities of enamel insulation. The company believes it has at the present time the most complete equipment in existence for the manufacture of enameled magnet wire. It has recently organized a new department for coil windings, which is in charge of Mr. C. R. Underhill, formerly of New York City, and an authority on electromagnetic windings. Mr. Underhill has designed and installed many new winding machines, has equipped the testing department throughout with new and improved instruments and has quadrupled the output of this department. The new building, which is to accommodate these two related departments, will cover a ground area of 150 x 60 ft., and will eventually be carried up to the full height of the company's other buildings.

Weekly Record of Electrical Patents

UNITED STATES PATENTS ISSUED JUNE 7, 1910.

[Conducted by W. F. Bissing, Patent Law, 2 Rector St., N. Y. City.]

960,291. AERIAL ELECTRIC CABLE; C. E. Egner, Stockholm, Sweden, and R. F. Fredrikson, Gottenborg, Sweden. App. filed Dec. 1, 1908. A sheating, conducting wires therein, and a sheathed carrier for suspending the cable, the sheathing of which is integral with the sheathing of the cable.

960,304. WIRELESS TELEGRAPHY; R. C. Galletti, Rome, N. Y. App. filed Dec. 20, 1907. A closed oscillating circuit coupled with an antenna, the duration of the emission of the energy by the antenna being continued until the emission reaches the steady condition.

960,324. ELECTRIC SWITCH; E. M. Hewlett, Schnectady, N. Y. App. filed Sept. 2, 1905. A plurality of switches, manually controlled means for opening one of them and automatic mechanism subsequently operative, first to open another switch and then to close both switches.

960,354. SELF-LUBRICATING BEARING FOR TROLLEY WHEELS; A. M. Levering, Philadelphia, Pa. App. filed June 15, 1909. An improved oil cup secured to the trolley fork supplying oil through a wick to the journal pin.

960,361. ELECTROPNEUMATIC AIR BRAKE SYSTEM; G. Macloskie, Schenectady, N. Y. App. filed Feb. 1, 1910. The valves are controlled electrically, there being two independently electrically operated valves for admitting air to the brake cylinder, thus admitting air simultaneously to two valves on emergencies.

960,383. DYNAMO ELECTRIC MACHINE; J. E. Noeggerath, Schenectady, N. Y. App. filed April 26, 1909. Unipolar machine which may be used as a variable voltage rotary transformer.

960,409. ELECTRIC HEATER; J. C. Royce, Toronto, Ontario, Canada. App. filed May 14, 1909. A thin flat strip of metal wound in volute coil form with a layer of insulating material between and a metal band encircling the coil, with its ends secured together.

960,414. TWIN LAMP SOCKET; H. R. Sargent, Schenectady, N. Y. App. filed Aug. 21, 1909. Twin lamp sockets having a base with two aligned screw threaded shells parallel therewith, and a trough-shaped cover fitting over the shells.

960,440. COMPENSATOR; E. Thomson, Swampscott, Mass. App. filed Feb. 10, 1908. Compensating or reducing transformer with a coil of high induction in series therewith, the connection between which and the source of the current is automatically cut and the source connected directly to the transformer on full load.

960,449. DYNAMO ELECTRIC MACHINE; L. E. Underwood, Lynn, Mass. App. filed April 3, 1909. For ventilation by means of a fan connected to the shaft with an end member and openings around the bearing.

960,450. SWITCH CONSTRUCTION; H. L. Van Valkenburg, Norwood, Ohio. App. filed June 22, 1905. For connections to measuring instruments on station switch boards consisting of a plurality of switch units or blocks and a movable switch member shiftable in openings through the blocks.

960,458. TELEPHONE REPEATER; N. G. Warth, Columbus, Ohio. App. filed Dec. 14, 1908. Makes use of a double relay, one auxiliary to the other, the receiving element of a granular transmitter being in the local circuit and acting as a transmitter, the secondary repeater being operated by the receiver.

960,466. ILLUMINATING BODY; G. Weissmann, Paris, France. App. filed Jan. 8, 1909. Figure sign consisting of a flat body, to which lamps are inserted and held in place by a metal cup and spring.

960,482. MULTIPLE-TELEGRAPH SYSTEM; E. P. Batzel, Buffalo, N. Y. App. filed March 3, 1909. Employs currents of different frequencies and intensities for actuating the signals.

960,495. CURRENT REINFORCING MEANS; R. C. Browne, Salem, Mass. App. filed May 25, 1907. For telephones including a magnet with pole pieces and magnetization coil, a variable resistance, movable poles in the fields of said fixed poles to produce the pressure and suitable electrodes.

960,504. POWER OPERATED SWITCH OR CIRCUIT BREAKER; H. W. Cheney, Norwood, Ohio. App. filed Oct. 20, 1905. For opening circuits of high potential and large amperage by means of a rotary shaft, which carries a weight and contact drum, a motor for lifting the weight without moving the shaft, a clutch between weight and shaft whereby the falling weight moves the contact members successively into and out of engagement.

960,505. MULTIPLE VOLTAGE SYSTEM OF MOTOR CONTROL; H. W. Cheney, Milwaukee, Wis. App. filed Oct. 6, 1909. Improvement on patent 797,271 in the manner of controlling and cutting out the buffer resistance.

960,553. ALTERNATING CURRENT TRANSLATING DEVICE; L. F. Howard, Edgewood Park, Pa. App. filed April 25, 1907. Alternating current relay energizing relay for use in railway signaling systems, which is traversed at times by alternating currents of different frequencies and has a core with two magnetic paths each, including one set of poles of a larger end area than the other set, the fluxes acting upon a vane.

960,559. TROLLEY FOR ELECTRICALLY PROPELLED VEHICLES; J. Kolin, Chicago, Ill. App. filed May 24, 1909. A trolley which will not leave the wire and also acts as an ice scraper. The harp carries two levers actuated by a toggle connected to the rope, the ends of the lever embracing the trolley wire.

960,567. ELECTRIC ACCUMULATOR; L. Marseille and P. Gouin, Levallois-Perret, France. App. filed July 1, 1909. Alkaline accumulator support on the exterior of which a hard layer of nickel oxide is deposited to prevent the dropping of the active material.

960,586. SIGNALING SYSTEM; H. O. Rugh, Sandwich, Ill. App. filed Feb. 15, 1909. Selective signaling system with a telephone at each substation for the train dispatcher, so that he may call any desired station.

960,608. PURIFICATION OF LIQUIDS; A. E. Williams, Jersey City, N. J. App. filed March 22, 1909. A receiving chamber, an electromagnet at the bottom with strainer in the upper part, a supplemental chamber into which the liquid passes after going through the strainer and a series of screens in the supplemental chamber connected to an electric circuit.

960,626. ELECTRIC SWITCH FOR INCANDESCENT LAMP CIRCUITS; W. B. Crossland, De Soto, Mo. App. filed Aug. 9, 1909. For tungsten lamps, including a current resistance and device for retarding the opening and closing of the switch, the resistance and device consisting of a hollow structure with a restricted opening through which liquid passes during the operation of the switch.

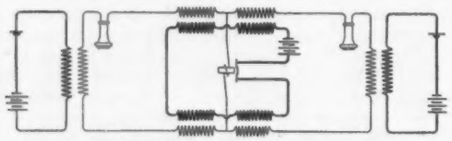
960,631. WIRELESS SIGNALING; R. A. Fessenden, Brant Rock, Mass. App. filed Oct. 10, 1907. For producing and receiving wireless signals without interference, by means of a generator of continuous impulses at the sending station, a generator of continuous impulses as the receiving station, and means at the receiving station whereby the impulses silence the locally produced sound, except when the sent impulses are interrupted by signaling.

960,654. PUSH BUTTON; D. R. Lovejoy, Irvington, N. Y. App. filed March 8, 1907. A circuit closing bar, a spring loop on a spring serving as a binding post, and another portion as a contact for the bar.

960,665. PIANO ATTACHMENT FOR GIVING MANDOLIN EFFECTS; J. Metzger, Cambridge, Mass. App. filed Nov. 1, 1909. A plurality of auxiliary hammers and electrical means for causing them to strike the strings in rapid succession.

960,668. MAGNETIC SEPARATOR; W. B. Moore, Seattle, Wash. App. filed Aug. 31, 1906. A support to which materials are fed, the support having an extension inclined upwardly in an outward direction, there being an opening at the base closed by a valve and a magnet for causing the magnetic particles to travel on the support.

960,681. ELECTRODE FOR WELDING, ETC.; W. A. Neff, Cleveland, Ohio. App. filed Nov. 20, 1907. A holder, a block of high resistance



960,495—Current Reinforcing Means.

material thereon, an incombustible coating surrounding the block and removable bands for holding the coating in place.

960,683. SYSTEM FOR THE GENERATION AND DISTRIBUTION OF ELECTRIC CURRENTS; R. M. Newbold, Chicago, Ill. App. filed July 9, 1908. A self-exciting dynamo, driven at variable speeds, a storage battery, and a worked circuit with automatic regulation of the dynamo by regulating the field, through an electromagnet with a switch.

960,712. PROCESS OF PURIFYING ALUMINOUS MATERIALS; L. E. Saunders, Niagara Falls, N. Y. App. filed Sept. 14, 1909. Process of purifying aluminous material by fusing it in the presence of carbon in excess, producing a molten bath of aluminum carbid separating the impurities and oxidizing the carbid.

960,731. TELEPHONE RECEIVER; W. F. Taylor, Brookline, Mass. App. filed Aug. 8, 1908. Testing receiver in which the circuit controller is within the receiver, below the diaphragm and operated by a rocker arm with a lever projecting outside of the receiver case.

960,734. VOLTAGE-REGULATOR; W. I. Thomson, Newark, N. J. App. filed April 15, 1905. A voltage controlled magnet, a variable resistance, a motor with rotary armature connected thereto, and having opposing field windings, a movable contact connected to the field and a pair of contacts connected with the outer ends of the windings and normally free from the movable contact, but adapted to alternately make connection therewith.

960,744. ELECTRIC-CONDUIT FITTING; J. C. Vogel, Philadelphia, Pa. App. filed Jan. 17, 1907. A plurality of branches at an angle enlarged at the junction, with removable cover.

960,773. ELECTRIC FURNACE; T. F. Baily, Alliance, Ohio. App. filed Sept. 7, 1909. A furnace with walls to form a heating chamber having an opening with a body of resistance material in the heating chamber and spaced electrodes in contact therewith.

960,774. SPEED-CONTROLLING DEVICE APPLICABLE TO ELECTRIC MOTORS AND GENERATORS; D. Balachowsky, Paris, and Philippe Caire, Levallois-Paris, France. App. filed May 8, 1907. For regulating shunt wound motor by a coil of varying cross section exciting the fields.

960,776. ELECTRICALLY OPERATED LOCK; H. S. Balliet, New York, N. Y. App. filed Oct. 18, 1909. For controlling levers for switches, signals, and the like with an electrically operated lock for locking the lever.

960,807. STREET-LAMP SOCKET; C. L. Bundy and Albert H. Manwaring, Philadelphia, Pa. App. filed Aug. 16, 1909. For series incandescent lamps to avoid breaking the filament, by means of a receptacle having automatic line-closing contacts, and a lamp socket receiving a lamp and means for breaking the spring contact and leading the current to the contacts of the lamp receptacle.

960,808. INCANDESCENT-LAMP RECEPTACLE; H. U. Badeau, Bridgeport, Conn. App. filed Dec. 23, 1909. For series incandescent lighting including a receptacle having automatic line-closing contacts, an independent lamp socket and means to establish the socket circuit upon the parting of the line-closing contact in combination with means to protect the line contacts from the action of the elements.

960,829. TROLLEY FOR ELECTRIC RAILWAYS; C. D. Coyle, Youngstown, Ohio. App. filed Nov. 15, 1909. A swiveled trolley harp which is self-adjusting to the run of the wire.

960,856. DUPLEX TELEPHONE CONNECTION; A. W. Ebeling, Charlottenburg, Germany. App. filed July 7, 1909. With self-inducting load of the Pupin system provided with an additional set of double coils alternating with the Pupin set, the single coils of the two sets beng traversed by the current in series on one line and the single coils of the other line being traversed in opposite sense.

960,862. ELECTRIC FURNACE; J. W. Evans, Belleville, Ontario, Canada. App. filed July 15, 1909. An electric furnace including a chamber with horizontal electrodes, a pair of separate electrodes and means for operating the electrodes at will, the horizontal electrodes being arranged to produce an arc above the material in the chamber.

960,863. METHOD OF REDUCING REFRACTORY MATERIAL; J. W. Evans, Belleville, Ontario, Canada. App. filed July 15, 1909. An electric furnace with horizontal electrodes and means for producing an arc above the molten mass, then cutting off the molten mass and then passing the current through the molten material.

960,875. BRUSH-HOLDER; A. Freier, Boston, Mass. App. filed July 13, 1908. Carbon brush holder pivotally connected with a supporting frame, which is clamped to the dynamo, the adjustment of the tension on the brush being independent of the main-frame connection.

960,881. ALTERNATING CURRENT MOTOR; V. A. Fynn, London, Eng. App. filed March 6, 1909. Single phase induction motor with the induced and commuted winding closed over brackets and along more than one axis per pole pair.

960,882. POLYPHASE COMMUTATOR MOTOR; V. A. Fynn, London, Eng. App. filed June 1, 1909. With shunt characteristic and having a neutralizing winding for each phase on the stator in series relation with the rotor along an axis coinciding with that of the neutralizing winding.

960,883. POLYPHASE COMMUTATOR MOTOR; V. A. Fynn, London, Eng. App. filed June 1, 1909. With a shunt characteristic for variable speed, to be worked either as a conductor or induction motor or as a combination of the two.

960,884. ALTERNATE-CURRENT COMMUTATOR MOTOR; V. A. Fynn, London, Eng. App. filed Nov. 26, 1909. Single-phase induction motor with improved starting and operating means.

960,896. CONTROLLER FOR ELECTRIC MOTORS; E. Gruenfeldt, Cleveland, Ohio. App. filed July 26, 1909. Controller mechanism for a series wound motor with a plurality of field coils, the resistance being first thrown in series, then in parallel with the field coils, and then in parallel with each other, and controlling a shunt of one of the field windings by means of a switch.

960,911. ELECTRIC ARC LAMP; W. H. Headland, Leyton, Eng., and Frederic Plutte, London, Eng. App. filed Oct. 28, 1907. For feeding and regulating arc lamp carbons containing groups of inclined carbons with means for rotating the supports to revolve them and moving the supports to feed them.

960,925. COMBINED SYNCHRONIZING AND TELEPHONE SYSTEM; G. E. Hoglund, Chicago, Ill. App. filed March 5, 1910. For synchronizing two machines and permitting telephone messages to be transmitted over the same circuit used for synchronizing, as for combination phonograph and moving picture shows.

960,928. POLARIZED RELAY; W. K. Howe, Rochester, N. Y. App. filed May 19, 1909. Polarized relay in which the armature is automatically returned to neutral position when the relay is de-energized by means of a permanent magnet.

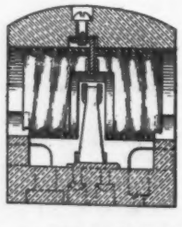
960,962. METALLIC-FILAMENT ELECTRIC GLOW-LAMP; H. Kuzel, Baden, near Vienna, Austria-Hungary. App. filed March 31, 1908. Means for supporting the bright portion of the filament.

960,970. AUTOMATIC CIRCUIT-BREAKER; H. W. Leonard, Bronxville, N. Y. App. filed March 21, 1901. A switch with means including a winding for controlling the opening of the switch, a relay actuated by reverse current for closing a circuit through the winding and a second independently movable switch protectively related to the first switch.

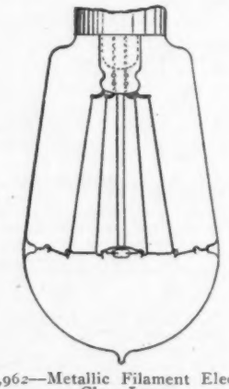
960,971. MEANS FOR AUTOMATICALLY CONTROLLING ELECTRIC MOTORS. H. W. Leonard, Bronxville N. Y. App. filed Feb. 6, 1897. For mines to keep the water level drained to a certain depth. The water drives a pump and is controlled by two mechanically connected electromotive forces producing windings with means controlled by the condition of the fluid pumped for controlling the motor.

960,995. LIFTING-MAGNET CONTROLLER; J. F. Motz, Pittsburgh, Pa. App. filed Dec. 17, 1907. Has an inductive winding, a magnetically-operated switch, a resistance, a controlling hand-operating switch with contacts to close the circuit across the line.

961,025. ELEVATOR ANNUNCIATOR; W. W. Savage, Buffalo, N. Y. App. filed Feb. 18, 1909. A signal for elevators including a plurality of lamps arranged in tiers, which indicate the floors, a plurality of



960 414—Twin Lamp Socket.



960,962—Metallic Filament Electric Glow Lamp.

manual switches on each floor with means for automatically opening the switches when the electrically controlled means have been deprived of current.

961,033. CUP OR HEAD FOR MASSAGE DEVICES; C. M. Siebert, Jr., Columbus, Ohio. App. filed Aug. 3, 1909. A body, a flexible diaphragm clamped thereto, and an insulating ring which slips down over the clamp.

961,036. ELECTRIC SIGNAL-SOUNDING APPARATUS; A. L. Sohm, Whittier, Cal. App. filed Sept. 4, 1908. Electric signal-sounding apparatus, having a plurality of groups of contact elements with electrically operated means for moving selective ones of said elements into an operative position.